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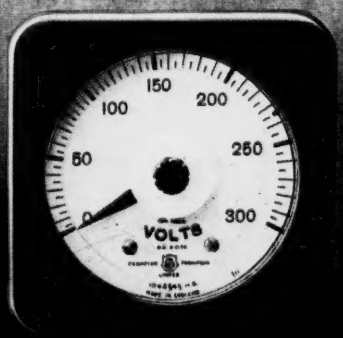

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ELECTRICAL REVIEW

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3 JUNE 1955

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VOLUME 156 ✧ NUMBER 22

Eighty-Third Year of Publication

FRIDAY ✧ PRICE 1s 6d

Editorial, Advertising and Publishing Offices : Dorset House, Stamford Street, London, S.E.1. Telegraphic Address : "Elecrev, Sedist, London." Code: ABC. Telephone No. Waterloo 3333 (60 lines). Registered at the General Post Office as a Newspaper. Entered as Second Class Matter at the New York, U.S.A., Post Office. Annual Subscription : Home and Overseas £4 10s 0d : U.S.A. and Canada $14.00. Cheques and Postal Orders (on Chief Office, London) payable to ELECTRICAL REVIEW PUBLICATIONS LTD., and crossed "Lloyds Bank."

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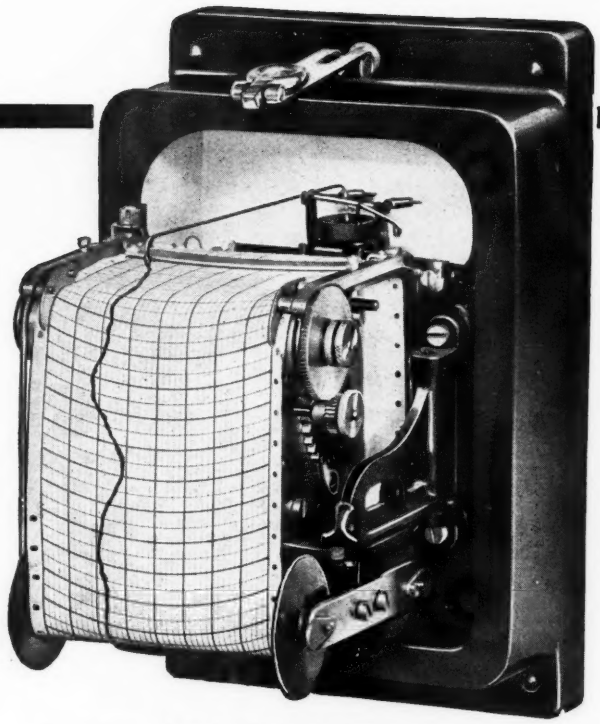

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ELECTRICAL REVIEW

3 June 1955 Vol. 156 No. 22 Established 1872

Engineers and Natural Resources

AT first it seems a far cry from water and soil to electrical engineering but in the Graham Clark Lecture "The Engineer's Contribution to the Conservation of Natural Resources" which Sir Harold Hartley, K.C.V.O., F.R.S., delivered at a joint meeting of the Institutions of Civil, Mechanical and Electrical Engineers recently, *vide Electrical Review*, 13th May, he showed how these common substances are fundamental to all engineering—a simple truism which is so easily lost sight of when we become concerned with the many branches of modern technology. The lecturer said that water was proving more and more to be the indispensable resource on which plans so often had to be based, and its conservation had the highest priority.

Electrically we in this country would, no doubt, pending the arrival of atomic energy on a commercial basis, give coal the highest priority, but Sir Harold presents us with the broader world picture with hydro-electric power taking a leading place, particularly as part of irrigation projects which make such important contributions to civilization. Here one of the greatest problems of conservation is silting of the soil into the reservoirs, something which appears to the electrical engineering mind, at any rate in this country, as remote. But when it is shown that with the loss of storage capacity the output of the power station would become more and more dependent on the seasonal flow of water a serious picture confronts the engineer. And we are much impressed by the lecturer's portrayal of the design and construction of dams as combined operations of civil, mechanical and electrical engineers—a most important point in these days when a reaction to the approach of so much modern technology is a call for "honest to goodness" engineering.

It has certainly been difficult for some years in this country to find inland sites for steam stations with adequate cooling water supplies, and it appears that this problem will be emphasized in connection with the nuclear energy power stations. But no doubt from the point of view of providing power the greatest contribution of the engineer lies in his conservation of fuel, particularly coal, by increasing the efficiency of combustion.

The advent of nuclear energy will enable coal and other energy resources to be used more and more as a source of chemicals, and here again we can see another great example of combined operations by electrical, chemical, mechanical and civil engineers. Sir Harold also dealt with the engineer's conservation of human effort and in this connection a great contribution has been made by materials handling—another excellent example of co-operative activities of the electrical, mechanical and production engineers.

There could not be a more appropriate subject than Sir Harold's in furthering Graham Clark's aim, as Mr. J. Eccles (President I.E.E.) put it, of "widening the outlook of engineers and particularly lifting their sights from pure technology to something more appropriate to their existence as human beings."

ATOMIC HEAT TRANSFER

In his James Forrest Lecture to the Institution of Civil Engineers last week, briefly summarized in this issue, Sir John Cockcroft, director of the Atomic Energy Research Establishment, Harwell, is reported to have described the experimental "fast breeder" reactor at Dounreay as the physicist's dream, but to some extent the engineer's nightmare—presumably because "the required rate of extraction of heat from a given weight of material is perhaps 100 times as great as that in the most highly rated boiler." We believe the electro-mechanical power engineer will accept this as a challenge rather than as a "nightmare," for is it not reasonable to expect that at least some of the extracted heat could be used to improve steam conditions? As far as we have been told the position now is that we must accept the low steam conditions which prevailed, say, 30 or 40 years ago, and that was the position when the decision to build Calder Hall was announced more than two years ago. It is difficult to believe that no advance has been made in this field in the past two years. If, as seems likely to be the case, information on this point is being held up, then the engineer is being severely handicapped.

THE COMPUTER JUSTIFIED

In an address to the recent national conference of the Office Management Association at Brighton the Earl of Halsbury, managing director of the National Research Development Corporation, showed how the development and survival of the computer had confuted all the adverse predictions of the early days when in one respect it was rather like the first atomic bomb; no one was quite sure whether it would work or not until it actually did so. In theory the "Eniac" ought not to have worked. It had about 20,000 valves in it and the known rate of valve failures was then such that the estimated time required to locate and replace one faulty unit out of 20,000 was about equal to the estimated interval between failures. It looked as if "Eniac" would spend the whole of its life being maintained, leaving no time for mathematical calculation. Computers which at first worked for minutes at a time only gradually began to offer trouble-free runs of an hour or more. Then the useful time reached 80 or 90 per cent of the total periods and now after ten years near certainty of continuous operation has been reached.

E.C.A. CONFERENCE

This year's annual conference of the Electrical Contractors' Association and its allied organizations opens at Margate on Sunday with the registration of delegates during the afternoon and a concert in the evening. The arrangements are somewhat different from those followed in previous years. Monday morning will be devoted to the usual civic welcome and the address by the President (Mr. A. F. Plummer, M.C., Associate I.E.E.), followed by a paper on hire-purchase by Mr. C. C. Worters, secretary of the Hire-Purchase Association. A garden party will be held at Dover in the afternoon and there will be no evening function. Tuesday's proceedings open with the annual general meeting and in the afternoon a four-part paper on sales promotion will be presented by Messrs. H. S. Wathes, N. C. Walker, J. P. Ingles and R. Cussins. After a discussion on the paper the new president will be installed and will deliver a short address. The final item is to be a joint reception by the Mayor of Margate and the President.

IDENTICAL TENDERS

Much stir was created last week by a report that eight British companies had put in identical tenders for the supply of transformers to the Snowy Mountains hydro-electric scheme, Australia, and that the contract had been awarded to the Belgian A.C.E.C. The Australian Minister for National Development, Senator W. H. Spooner, strongly criticized the method adopted by the British concerns, alleging that they had formed a price ring. It was replied on behalf of the manufacturers that the reference to a price ring was unjustified and that the quotation of the same price by eight firms represented a united effort to reduce prices to the minimum to meet foreign competition; in fact, it was said, the British prices were below that of the successful Belgian concern. (Reports from Australia indicated that the A.C.E.C. bid was the lowest, although no figures have been disclosed. We believe that the amount involved was only about £50,000.) Whether this reply is acceptable or not, the system of quoting identical prices is bound to create suspicion; tenderers cannot expect buyers (particularly those overseas with all the world to choose from) to believe that their action is in the buyers' interest.

THE TWO ASPECTS

The common idea that studies devoted to what are usually termed "humanities" make a person better fitted for modern social life than those that only impart a knowledge of science and technology is surely an anachronism. A one-sided form of education is in any case undesirable, as Mr. S. Rubinstein stated in an address reported in this issue, and the "arts" student should have some acquaintance with science and a scientific approach to problems of everyday life. On the other hand it is now more than ever important, as he pointed out, that technical students should be reasonably well informed on matters that go to make up the pattern of society in which they must increasingly take the lead.

ELECTRIC TOASTERS

Continuing our series of illustrated surveys of domestic electrical appliances, next week (10th June) we shall be dealing with electric toasters. Included in the particulars to be given in tabular form will be details of the type, number of slices, loading, special features, finish and price. In view of the continued demand for these surveys for reference purposes, orders for additional copies of the *Electrical Review* should be placed without delay. The subject of the following survey (1st July) will be

food and drink mixers

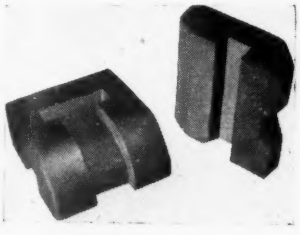
PLASTICS and the ELECTRICAL INDUSTRY

The 1955 British Plastics Exhibition

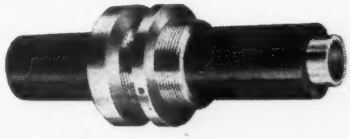
THE British Plastics Exhibition, organized by *British Plastics* and held biennially, opened on Wednesday at Olympia, London. An excellent display representative of all branches of the industry can be seen and over a hundred manufacturers are taking part, among them many whose names will be familiar to electrical buyers. It remains open until 11th June.

A noticeable trend in the application of plastics to the electrical industry is in the increased use being made of nylon as an insulating material and for use in situations occasioning wear due to rubbing. Materials such as "Perspex," polythene, polystyrene, p.v.c., etc., are being extensively used for lighting fittings as well as for innumerable small domestic items.

Among those exhibitors whose products are used for their insulation properties is Utilex, Ltd., who are showing cellulose acetate material used for electrical tapes, slot liners, etc., and for all purposes where varnished fabric tapes have hitherto been employed. In many cases this can replace mica and mica tapes and in the form of a thicker sheeting it can be used as a dielectric in condensers. Tufnol, Ltd., show examples of their material rolled and moulded on to a metal centre for use inside circuit-breakers, machined into insulators for supporting the live rail on electric railways, thus considerably reducing breakages, and manufactured into gear wheels ranging from small instrument gears to large pinions for heavy load transmission. Capacitors potted or sealed with "Epikote" resin are shown on the stand of Shell Chemicals, Ltd., as also are small transformers in this material and aircraft electrical components potted in foamed "Epikote." Birkbys, Ltd., show examples of mouldings made from their "Elo" powders and also insulating varnishes and anti-friction resins for fabric bearings.



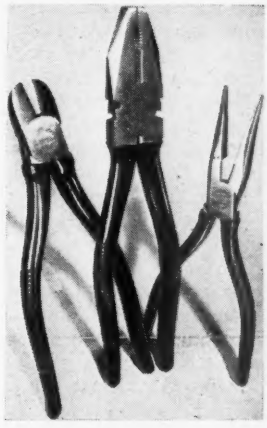
Left: Tufnol live rail insulators



Tufnol bushing for circuit-breaker

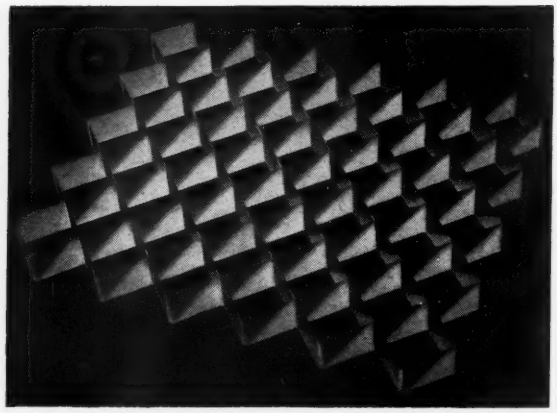
Ten different plastics materials are represented in a display of insulations illustrating the General Electric Company's versatility in this field. This concern possesses one of the largest moulding shops in the country and produces more than 2,500,000 mouldings a week. Samples on display include radio cabinets, torch cases, meter cases and washing machine agitators. A number of items in nylon are shown including gear wheels, bushes and bearings and even football studs. Bakelite, Ltd., show mouldings in their new alkyd materials which possess excellent electrical properties and can be produced in both bright and pastel colours; and also of interest to electrical engineers will be the use of circuits printed on their copper-clad laminated sheet, in electrical assemblies. This material provides in one unit both chassis and circuit connections, and eliminates wiring.

Several firms show materials used in the cladding of cables both as insulants and as sheaths, including the Phœnix Rubber Co., Ltd., with examples of p.v.c. sheeting and tape and Monsanto Chemicals, whose "Aroclors" are similarly used. The "Aroclors" are a range of chlorinated diphenyls offering flame resistant qualities when used as plasticizer extenders; they are used also as capacitor impregnants permitting reduction in capacitor size of as much as 40 per cent when compared with oil impregnated capacitors of equivalent rating. Lacrinoid Products, Ltd., show many examples of the use of their versatile p.v.c. material "Vietum" which is used as a covering for rods, tubes, and bars and is slipped over the material to be covered and warmed, when it contracts and produces a firm and permanent covering. This material has been used for low voltage busbar insulation, condenser protection and for insulating the handles of pliers. "Telcothene" is a well-known product of the Telegraph Construction & Maintenance Co., Ltd., and many examples of its uses are shown on their stand, with "Telcohesive" jointing tape and "Telcompound" for joint box filling.



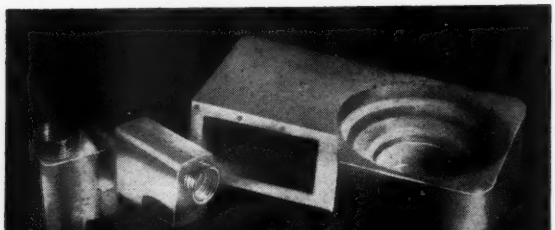
Pliers with "Vietum" insulated handles tested to 10,000 V

A very large number of firms in this industry, although not manufacturing materials in everyday use for insulating purposes, produce plastic mouldings used by most of the electrical and radio manufacturers in the country for a wide variety of tasks. Universal Metal Products, Ltd., have a large range of plastic mouldings including domestic electricity meter cases and terminal blocks, coil formers and component parts for heavy electrical equipment such as generators, transformers and switchgear; and they also show quite a new departure in the use of high impact grades of polystyrene for the manufacture of radio cabinets



Kenmure fluorescent light diffuser moulded in one piece

Below: Kenmure moulding for Ultra hand microphone



and television fronts. National Plastics, Ltd., show small components in nylon and alkyd materials used in electronics, cabinets for clock radios and an example of a heavy phenolic moulding carrying the fuses of a circuit breaker; Mica Products, Ltd., show injection mouldings of thermo-plastic materials for radio and television work; Punfield & Barstow, Ltd., moulded accumulator cases, battery boxes, switch dollies, valve holders, etc.; and Kent Mouldings, similar products.

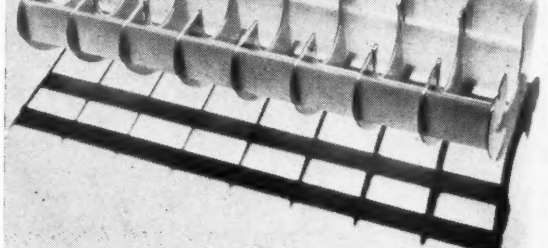
Standard electrical grades of sheeting, tubes and rods by Thermo-Plastics, Ltd., are on view. A tank made from sheet polythene is shown by Halex, who display injection mouldings used for refrigerators and radios. Many exhibitors have examples of plastic materials used in conjunction with fluorescent lighting, both for holders and for dispersers including Litholite Insulators & St. Albans Mouldings, Ltd., Injection Moulders, Ltd., and J. F. Kenure, Ltd. Injection Moulders also show radio cabinets in cellulose butyrate, switch rings, pick ups, plug sockets and a strain relief bush moulded in nylon material and intended for use where a cable or flex enters a chassis, where it forms a positive lock on the cable at the point of entry, thus reducing the possibility of damage at connection points.

Domestic Plastics

"Plastics at Home" is the theme of the I.C.I. Plastics Division stand, which shows a kitchen, bathroom and nursery in which many plastic materials are incorporated, ranging from p.v.c. tiles to "Darvic" linings in the refrigerator, "Perspex" lighting fittings and a moulded television cabinet. Styrene Products, Ltd., exhibit various grades of polystyrene, among them a heat resistant grade exhibiting excellent electrical properties and a heat resistant high impact grade combining good electrical properties and heat resistance with the added advantage of high impact strength, flexural strength and elongation. A unit lighting fitting made by Tube Lamination & Engineering, Ltd., is shown as an example of the use of their material.

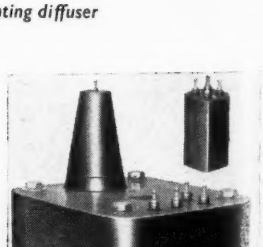
As usual, many types of plant for the production of plastic items have been installed in the exhibition and are shown in operation. Electrical controls, some quite complex, are used on all these machines, some of which include high frequency heating arrangements.

T. H. & J. Daniels, Ltd., are showing, jointly with Alfred Herbert, Ltd., a complete range of plant for the thermo-setting and thermo-plastics field, including an improved type of press for compression or transfer moulding with a capacity of 200 tons and having electrically heated platens 30in square with thermostatic control. Time cycle control is included. Thermo-plastic sheet welders from the "Radyne" range of Radio Heaters, Ltd., are to be seen performing operations in the production of plastic raincoats. Two new models have outputs of 1½ kW and 3 kW at approximately 37 Mc/s and on these the oscillator is situated under the table thus giving ample clear space for laying out patterns, etc. Also on view is their portable 0·25 kW welder which has proved of considerable value to the packaging industry. Dowding & Doll, Ltd., have on view their automatic fast cycling injection moulding machine and their "Westminster" hand or power operated machines. A large range of electronic welding machines can be seen on the stand of Redifon, Ltd., including their new "Mini-welder," designed for finishing work on plastic garments and a 30 ton press capable of embossing seat upholstery for cars and coaches in a single shot operation. This press uses a 20 kW or an 8 kW heater. R. H.

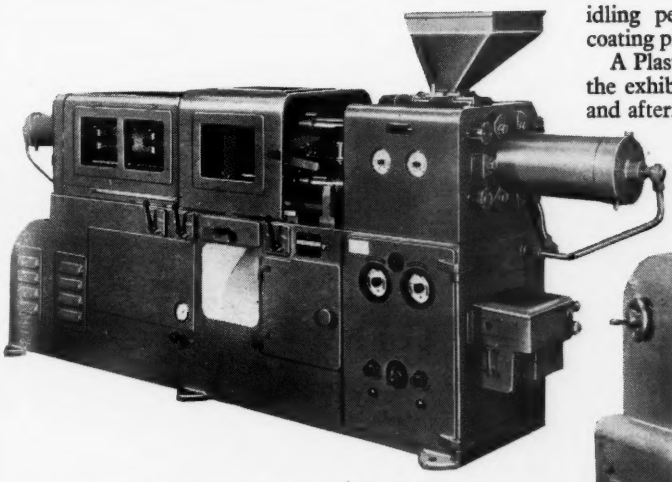


Styrene unit lighting diffuser

Injection Moulders, Ltd., strain relief bush in nylon



Gresham transformer potted in "Epikote" resin



Windsor S.H.4 automatic injection moulding machine

Windsor, Ltd., have various injection moulding machines on show and most may be operated on an automatic or semi-automatic cycle.

Comparable with the largest American machines in use is the " Formvac " vacuum forming machine being made by W. Edwards & Co., of Crawley, under licence from the Swiss firm of Hydro-Chemie. One of these on view is a twin table machine with an effective moulding area on each table of 40in by 60in. A new design of heater softens the thermo-plastic sheet two or three times faster than any other and is arranged so that it gives full heat only while it is over the work, quarter power being used during the idling period with a large electricity saving. Vacuum coating plant is also shown on this stand.

A Plastics Convention is being held in conjunction with the exhibition and sessions are being held every morning and afternoon from 2nd June to 9th June (with the exception of Saturday, 4th June) when papers are being presented on many aspects of the use and manufacture of plastics materials.

Dowding automatic fast cycling injection moulding machine

South Eastern Board's Progress

Suggestions to Manufacturers

AT the annual meeting of representatives of the South Eastern Electricity Board and of the manufacturers with whom the Board does business Mr. W. R. T. Skinner, deputy chairman of the Board, revealed that a surplus had been made in 1954-55. (In the preceding year there was a net deficit of £105,875.) Taking one year with another so far the Board had made a surplus which he took to be a measure of industrial efficiency.

The fact that there was no further remission of purchase tax was a disappointment, particularly in view of the Beaver Committee's recommendation that the tax should be taken off electric and gas water heaters and room heaters, none of which could be regarded as luxuries. There was probably nothing in the home that was, or could be, more helpful in producing a high load factor than the electric water heater which, however, was still subject to a 50 per cent purchase tax.

They were not so badly affected by the Hire-Purchase Control Order because it did not make a very large difference to the terms which they were already offering. They did not expect that it would do more than reduce to some extent the rate of increase of sales in the immediate future.

In its seventh year of operation the Board had connected the record number of over 37,700 additional consumers. Some 559 miles of new mains and 756 new substations had been provided during the year. New farm connections had averaged between nine and ten a week in the last seven years and the proportion of farms connected had risen from 44 to 72 per cent. The number of farms connected had thus risen by 60 per cent while the number of consumers generally had increased by 27 per cent. They were still anxious to see a greater use of electricity on farms.

Mr. Skinner said that he was glad to report that as a result of remarks he had made at the last meeting there had been little cause for complaint in the condition in which appliances had been received from the manufacturers, which removed a possible cause of dissatisfaction to the consumers.

After urging the manufacturers' representatives to keep in personal touch with the District and Sub-Area headquarters, Mr. Skinner pressed manufacturers to keep to promised delivery dates and he also made some suggestions about catalogues. The more convenient a catalogue was the more likely it was to be used. He thought that illustrations and prices should appear on the same page or on facing pages; terms such as " price on application " should be avoided; purchase tax should be stated as a sum of money and not merely as a percentage; price variations between revisions of catalogues printed on gummed slips which could be stuck over the old prices were appreciated; catalogues such as those of the loose-leaf type, which could

be readily and easily kept up to date, were of assistance; a required catalogue should be readily identifiable when standing with others on a bookshelf.

Manufacturers issuing more than one catalogue were asked whether these could be of uniform size to give greater convenience when storing on a bookshelf, and incidentally, to assist in the process of identification.

In his concluding remarks Mr. Skinner said there seemed to be no reason to suppose that they would connect any fewer new consumers than they did last year. Indeed there was every indication that they might connect slightly more. There would be no relaxation in their reinforcement and change-over programmes and rural development was expected to continue steadily at about the same rate as in recent years.

The rate of construction of a much-needed transmission system operating at 33 kV had been steadily increasing during the last few years. They expected it to continue at about its maximum rate throughout the current year. If all the expected developments came to pass, they were not likely to provide any less length of new mains or any fewer new substations than they did last year.

N.P.L. Annual Report

THE National Physical Laboratory's Report for 1954 has been published for the Department of Scientific and Industrial Research by H.M. Stationery Office, price 4s 0d net. Among other matters it records that detailed design work on the full scale computer " ACE " was started during the year in the Control Mechanisms and Electronics Division. The machine will be several times faster than the pilot model now in use, and it will have a memory of about a million digits and programming will be simpler. The electronic simulator was used for an extensive study of economic systems in conjunction with the London School of Economics. The dynamic stability of a country or a group of countries was considered, variables such as the index of retail prices being fed in.

The making and exploitation of diffraction gratings continues to be an important part of the work of the Light Division. The technique of making the gratings has been improved. Gratings for use as " scales " in industry must be ruled extremely accurately and their grooves must be shaped to produce moire fringes suitable for operating bi-directional counters. The first commercial infra-red spectrometer employing Merton-N.P.L. gratings was made during the year. Designed by the Light Division, its optical system is more effective than the traditional prism system and can be made for a small fraction of the cost. Some interesting research has been done on colour rendering. The work stems from the difficulties and problems brought to light by the new fluorescent mercury lamps. The main result of the research which has so far emerged is that memory for colour is extremely inaccurate. If the spectrum is divided into six bands, up to half of any one band can be removed and the observer will notice no difference in the colour rendering.

Most of the year's work of the Mathematics Division has consisted of solving problems for industry and for other Government Departments, using the " ACE " pilot model computer. One of the largest problems was the analysis of stresses set up in the steam catapult retardation structure in H.M.S. *Ark Royal*. The aircraft industry provided a large number of problems, such as spar analysis, analysis of test flight films, pressure distribution on wings and so on. For the English Electric Co., Ltd., the computer worked on the determination of critical speeds of various turbine generators and the calculation of stresses in systems of pipes.

During the past year work on the intercrystalline weakness of iron revealed that such weakness shows in many iron alloys. It is developed, for instance, in nitrogen-containing iron that has been heated for a very short time at about 700 deg C and then quenched. The weakness becomes more serious as the temperature at which the material is tested is lowered. Very small quantities of other impurities can cause intercrystalline weakness, too. The most striking effects have been obtained with phosphorus. Some samples, containing no more phosphorus than is found in commercial steels, are so weak at room temperature that they can be broken with the tap of a hammer. Research on this problem will be pursued, for it has great significance in relation to the failure of steel structures at low temperatures. One of the important points about it is that the heat treatments that produce the brittleness are similar to those often employed to soften a steel and relieve internal stresses. It seems quite possible that these treatments have produced slight brittleness in commercial steels, undetectable by normal methods, but enough to cause failure in exceptional circumstances. The Metallurgy Division is also making a start on studying materials for use in new power stations where steam temperatures of up to 1,400 deg F are possible. It is studying the effects of oxygen on the mechanical properties of titanium alloys, and carrying out other fundamental research on the metal, which is now rapidly becoming an industrial one. Creep and fatigue tests on commercial alloys for use in gas turbine compressors are in progress.

Higher Technical Education

IN the course of his presidential address to the Association of Teachers in Technical Institutions at its 46th annual conference, which opened on 29th May, Mr. S. Rubinstein (Derby Technical College) summarized the contributions made by technical colleges to the advance of higher technical education. There were, he said, 220 institutions in England and Wales which provided substantially for senior courses, i.e., at or above the standard reached by a good pupil at 16 years; in 74 of these students gained London University degrees and in 141 there were Higher National Certificate courses. Full-time students doing advanced work in major establishments numbered 4,736 for university courses and 6,140 for non-university courses; of these only 1 per cent were not doing work related to industry and commerce. For part-time day work the corresponding figures were 6,433 and 26,098, which compared well with the universities for which the totals were 29,273 full-time and 816 part-time students.

In the House of Lords debate last December a programme was outlined for expansion of higher technological education at the universities and at such places as the Imperial College, London, but no similar programme was proposed for technical colleges generally. The scope of the latter needed to be enlarged immediately so as to maintain the country's world position in industry. All the full-time trained scientists and technologists who could be produced from all available sources were required. This called for adequate allowances and scholarships without the differentiation indicated by local authority grants of £180 for university students compared with £50 for technical college students.

Solderless Wiring Connections

Pressure Jointing Methods

By R. PATEMAN*

ALTHOUGH various screws, clamps and soldering methods have long been the accepted ways of connecting copper cables to equipment, the increasing association of electrical and mechanical engineering has shown weaknesses in these methods not apparent in electricity supply installations. In such installations most of the wiring and equipment are stationary and not exposed to the extremes of temperature, humidity and vibration encountered, for example, by a modern aircraft and fighting vehicle or produced by heavy engineering and chemical plant. It is probably true to say that the aircraft industry was the first to be faced with these very stringent conditions and consequently the first to find fault with the old established practices and investigate pressure joint methods. In fact the point has now been reached when the use of contained pressure joints is compulsory on general services wiring in all British military and civil aircraft and is fast replacing soldered joints, now only found in certain radio equipment and instruments.

To avoid cable fractures in electrical installations subject to vibration or much manipulation it is essential that the conductors be composed of fine strands. These are easily damaged by pinch screws and other forms of clamp connector, commonly used with coarse stranded industrial cables.

Soft soldering has many disqualifications. Fluxes, mostly acidic, must be used to remove oxides in order to get a sound metallic bond. To bring all the strands into circuit continuity, both flux and solder must penetrate throughout the conductor. The entrapped flux contributes to after-corrosion, the solder solidifies the conductor and in addition the heat embrittles the copper strands at the point where flexibility is most needed with the result that any manipulation or vibration eventually breaks the cable. Most of these criticisms also apply to brazed or welded joints.

Some joints are most conveniently made on the site but since they cannot be soldered where inflammable gases or liquids are present much of the wiring used in coal mines has to be assembled on the surface and brought up again for repair or modification. Similarly, precautions have to be taken in oil refineries and explosives factories. With long and complex cable runs, the waste of time and materials is considerable.

Early forms of pressure joint employing bolted clamps are still used for line taps. They are quickly installed with standard spanners and offer adequate performance under normal current and moderate corrosive conditions although the pressure applied to the conductor is largely dependent on the strength and patience of the linesman. Very little pressure is exerted on the strands at right angles to the line of force. Creepage into these low pressure areas of oxides, sulphides and other corrosion-building elements is probable, leading to failure, particularly under high current surge and short-circuit conditions.

Contained Pressure Joints

As the description implies, contained pressure joints are produced by introducing the conductor into a close-fitting sleeve and deforming the latter by shaped dies so that all the strands are pressed into intimate contact with each other and the outer layer pressed into contact with the internal surface of the sleeve. Air spaces are eliminated and an almost solid mass produced for a sufficient length of cable to provide a satisfactory electrical and mechanical connection. This sleeve may be part of any termination, e.g., cable lug, connector pin and socket, or a number may be combined to form one junction unit, providing a means of connecting together two or more cables of different sizes.

Conductors of equal area but different strandings can usually be successfully jointed in a common size sleeve and two or more cables with different strandings have been joined together in one sleeve, using the standard dies. Also, within reason, smaller conductors than the termination was designed for can be used if the required area is obtained by adding material in the shape of a liner, made from tube or sheet, or alternatively by folding back the required number of conductor strands to fill the sleeve.

In an attempt to improve the contact area and mechanical strength of the joint, serrations or ridges are sometimes produced on the inner surface of the sleeve. However, where used with finely stranded conductors there is a risk that these serrations may sever the outer layer, or layers, of strands and there is no evidence to indicate that they make any contribution to interstrand contact. To achieve the necessary reduction in internal cross sectional area, the sleeve may be deformed into various shapes and advantages are claimed for configurations too numerous to be detailed here. However, those commonly used can be separated into two basic types known as "indent" and "compression."

Indent Types

To produce the indent type the sleeve is usually contained within a die and one or more depressions or indents are formed in it by shaped punches, the result produced being shown in Fig. 1 for some typical shapes. In addition

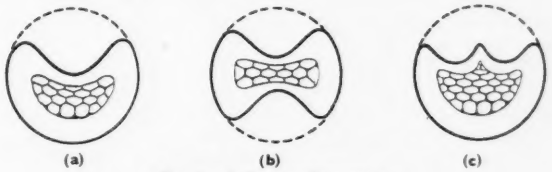


Fig. 1.—Indent configurations

to controlling the depth of indentation the better type of tool is designed to completely shroud the sleeve around the indent. This gives more consistent results and by preventing unwanted distortion makes it possible to indent the contact portion of a close-fitting plug pin, without impairing its operation in a socket. It is essential that the joint sleeve be made from a material sufficiently ductile to withstand cold working without fracture and thus ensure that the initial pressure applied to the cable strands does not relax but is maintained throughout the life of the joint.

* The Plessey Co., Ltd.

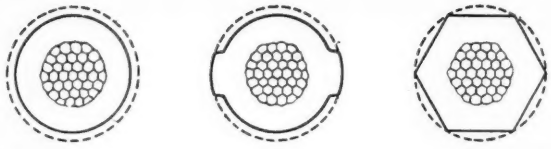


Fig. 2.—Compression configurations

Although the sleeve is usually made integral with the termination, where the function demands a material too hard to indent successfully, as in the case of spring sockets and switch blades, it is necessary to join a soft sleeve to the hard termination. A current example of this practice is a connector socket made of hard brass to which a soft copper sleeve is joined by swaging. Satisfactory joints can also be made with the popular types of pressed tag, where the conductor sleeve is rolled from the strip. To prevent the break in the wall of the sleeve from opening and releasing the pressure on the conductor, it is desirable to shroud the sleeve with a close-fitting seamless tube of similar material. The indent serves to lock the two parts together.

Compression Types

When using compression joints the aim is to reduce the conductor to a solid mass by applying a uniform peripheral pressure to each strand. Some typical configurations are shown in Fig. 2. As the wall of the cable sleeve is compressed and not stretched as with an indent joint there is very little risk of fracture and therefore a harder material can be used. However, it is as well to point out a general requirement for both indent and compression joints. It is that the cable sleeve should be softer than the conductor, otherwise the conductor strands may be reduced in area and extruded from the joint.

Naturally, tolerances on both conductor and sleeve must be catered for and to ensure that the strands compact under adverse limits some extra compressor movement is necessary. Once the strands have packed solid any further motion merely tends to extend the soft sleeve along the hard conductor. Experience has shown that compression joints require a thicker walled sleeve than indent types, although in the interests of economy experiments are still continuing to determine the minimum length and thickness that can be accepted.

At first sight, the circular swage depicted in Fig. 2 (a) would seem to be the most logical way of obtaining the desired results, at least on circular cables, but it has only been successfully applied by rotary swaging tools. For heavy cables, quite a large swaging machine is required and this makes the process impracticable for portable applications. The round or semi-round form depicted in Fig. 2 (b) has been in use for over 40 years on transmission lines in America with very good results. A hexagon form is shown in Fig. 2 (c). The hexagon is a natural nesting shape for the conductor strands and the sections shown in Fig. 3, taken before and after compression, show how each round strand has been deformed into a polygon closely approaching the shape of the regular hexagon compressed on the outside of the sleeve. Experiments have shown that, compared with other shapes, compressing to a hexagon provides the greatest ratio of reduction with the least amount of applied pressure, contributing to lighter and more convenient tools. The hexagon compression joint has therefore been adopted for fitting terminal lugs to Pren (copper) and Prenal (aluminium) cables used in aircraft.

In addition the hexagon form has particular advantages when considering the design of compression tools. Simple half dies can be used, parting across the corners of the hexagon. Initial pressure is exerted by the sloping sides of the hexagon and deforms the round sleeve oval, with the major axis in line with the die motion. The corners of the hexagon on the parting line are therefore formed last, just as the dies close. So, if the proportions are correctly chosen there is no risk of nipping the sleeve between the die faces, a problem with most other configurations that precludes the use of such simple dies.

All the disadvantages of soldered joints, previously mentioned in connection with copper cables, apply equally to aluminium cables, plus a greater degee of uncertainty about the final quality of the joints after spending more time and skill in making them, and aluminium is difficult to solder, although fluxes and solders for the purpose continue to improve.

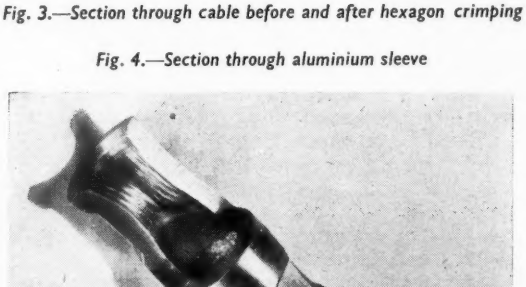
As aluminium conductors are larger than copper for the same current ratings it has not been considered desirable to use aluminium for light cables, where a small diameter is usually valued more than a reduction in weight. Therefore, up to the present most aluminium cables are above 30 A rating, sizes for which the indent type of joint is particularly unsuitable.

Although the process of indentation usually increases the area of contact between sleeve and conductor it also tends to apply greatest pressure and deformation to those strands immediately adjacent to the indent. This is particularly noticeable on large conductors with many strands. Whilst this may not be detrimental to copper joints, aluminium, being softer than copper, cold-flows more readily under pressure and the strands can be considerably reduced in cross section, possibly severed, by indent methods.

Considering all these facts, it would appear that the hexagon compression method is the best for jointing aluminium cables assuming the oxide film can be removed from the strands.

Fig. 3.—Section through cable before and after hexagon crimping

Fig. 4.—Section through aluminium sleeve



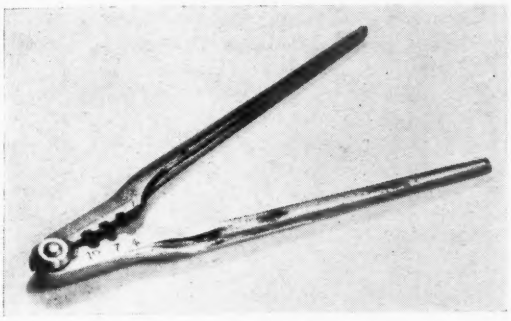
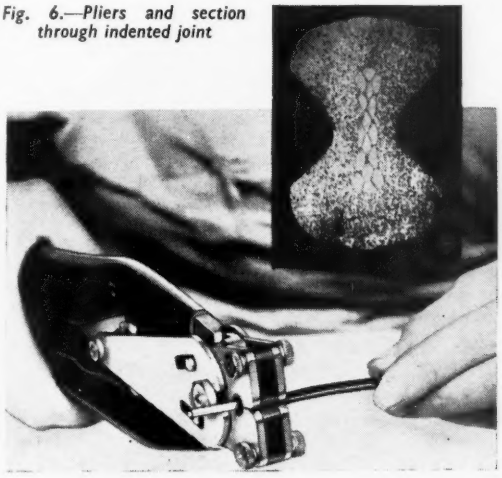


Fig. 5.—Simple indent tool

Fig. 6.—Pliers and section through indented joint



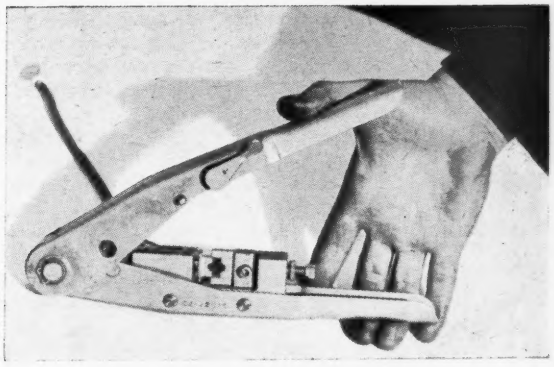


Fig. 7.—Heavy duty pliers

Most multi-strand cables consist of concentric layers of strands, one layer spiralled in one direction, the next layer in the opposite direction. Between strands in a layer there is a possible line contact, but only points of contact exist between layers. When the sleeve is being compressed on the cable its longitudinal and radial movements introduce a slip-plane action between the strands. This action removes portions of the oxide coating and continued pressure, whilst further cleaning the strands, increases the areas of contact between them until eventually, for some portion of the joint length, almost maximum possible interstrand contact is achieved. In fact, this pressure is great enough to cause some degree of cold welding between the strands and between the sleeve and the strands. The longitudinal section through an aluminium cable sleeve in Fig. 4 clearly shows the contact areas obtained between the outer layer of strands and the sleeve. Similar areas are formed between the strands.

Some experiments have been conducted with various oxide removing compounds, but largely because of the difficulty in applying them uniformly on all the strands throughout the joint, the results have been inconsistent and reliance cannot be placed on the effectiveness of these materials. It is far safer to use methods which do not rely on penetrating compounds but depend strictly on mechanical action to break through the oxide films and maintain contact efficiency through proper design and application. Inhibitor compounds, however, are recommended as a filler to prevent moisture and corrosive elements entering the joint between the strands.

The need for ductile high purity materials, when making joint sleeves, has already been mentioned, particularly with respect to indent joints. Although alloys may be preferred for high strength, up to date the best results have been achieved by making sleeves from a commercially pure grade of the conductor metal. Also by using metals with close matched coefficients of thermal expansion any pressure relaxation under extreme temperature conditions is avoided.

Copper cable lugs are normally tin plated and tin is a very good barrier metal for preventing electrolytic action between copper and aluminium. After much development work, a successful process for tin-plating aluminium is now available. By tin-plating copper and aluminium terminal lugs it is possible to connect both types of cable to a common terminal or busbar, which can also be made of either material. Thus the doubtful practice of coating mixed junctions with corrosion inhibitor pastes or paints is eliminated.

Tools for Pressure Jointing

Smooth working is a general requirement for all pressure jointing tools. The movement of the metal sleeve must not be too rapid. It is best done slowly so that the grain crystals have time for orientation. Besides being foolproof and easy to use tools must be accurately designed and robustly constructed to ensure that they continue to produce the required configuration for long periods, with the minimum attention.

In factories engaged on the mass production of preformed wiring looms, power operated tools are used, but when a limited number of different size joints are to be made or where the work must be done on site (e.g., overhead telephone and electricity supply lines), the portable plier type tool is favoured. Naturally, with the limited power available hand-mechanical tools are only capable of jointing small conductors.

A very simple plier tool with three sizes of single indent is shown in Fig. 5. A superior tool for double indent configuration is shown in Fig. 6 together with a microphotograph of a section through a 16/·012in cable joint it produces. The first action of this tool is to completely shroud the conductor sleeve against unwanted distortion. Further movement introduces the two punches simultaneously from opposite sides and they indent the sleeve equally to a controlled depth. Interchangeable dies cater for a number of sleeve diameters. The double indent, Fig. 1 (b), is preferred to the single form, Fig. 1 (a), for application to long slender terminations such as plug pins or telephone line joint sleeves, as there is less risk of bending the part with the balanced displacement of equal and opposite indents. A large plier tool shown in Fig. 7 employs a toggle action and is provided with dies for double indent on conductors up to 64 A rating and hexagon compression up to 50 A. It should be mentioned that

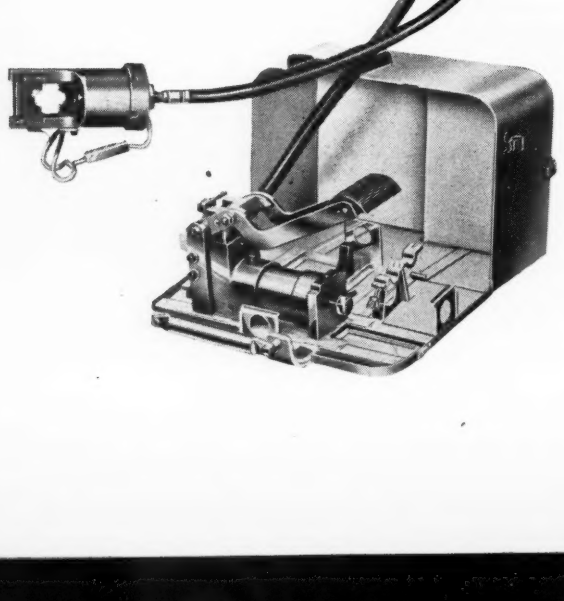
with some early designs of ratchet operating tools it was arranged that the sleeve could not be withdrawn until full compression had been achieved, and the snap over centre action of this toggle action tool helps to prevent the operator making incomplete, partially compressed joints.

For heavy cables, the hydraulic pump, hose and ram unit provide the maximum power and portability with minimum weight. Hydraulic power is also ideal for applying the force slowly and smoothly. Fig. 8 shows a foot-pump unit which can hexagon compress sleeves on to cables up to 300 A rating in half a minute, exerting a force of 13 tons, for a total weight, including fourteen pairs of dies, of 28 lb—light enough to be carried in one hand. Hydraulic compressors with 60 ton rams are in use and pumps can be hand, foot or motor operated. Additional lengths of hose with unspillable couplings enable the ram to be used remote from the pump where working space is restricted, or for such work as jointing overhead transmission lines.

On the unit shown in Fig. 8 the double piston pump is arranged to " change down " on to one piston at a ram pressure of 4/5 tons to keep the operating force down to a reasonable figure and reduce fatigue. Safety and fool-proofness are provided for by an overload valve in the pump which indicates to the operator by sound and feel that the dies are together and the joint completed.

It can be stated of both indent and compression jointing that if the right sleeve is fitted to the right conductor using the right tool, the resulting joints will be consistently good. To make sure the correct combination of sleeve, tool and cable has been used and also check cable stripping and fitting some inspection of the final joint is necessary. Designing a new type or size of joint is not merely a matter of achieving the correct area of reduction. Many criteria are involved; mechanical strength, temperature rise (at full rated current), volt drop, interstrand contact, corrosion resistance, effects of vibration, etc., have to be determined. However, once the development is complete and the design established, experience has indicated that only two quality control measurements are necessary in production, namely tensile strength and volt drop. Whilst a joint stronger than the cable has not been achieved, except for very small conductors, in most applications it is preferable for the cable to part from the sleeve than break at some unknown point, when subjected to excessive tension, although in all good joints on large conductors, portions of the outer strands are left cold-welded to the sleeve and to each other when tensile tested to destruction. Experiments have shown that good electrical performance is achieved at a fairly low tensile figure and improves only slightly with a large increase in mechanical strength.

Fig. 8.—Hydraulic unit



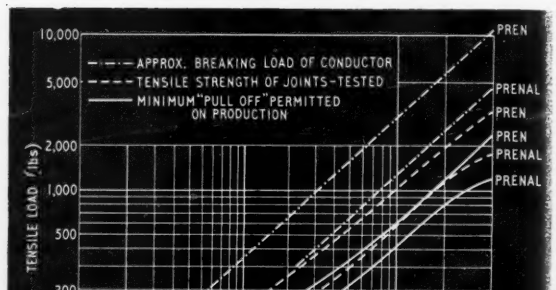


Fig. 9.—Hexagon compression joint data

Fig. 9 shows the relationship between cable strength, tested joint strength and minimum " pull off " permitted on production for hexagon joints on Pren (copper) and Prenal (aluminium) aircraft cables.

Although tensile strength increases with conductor area, volt drop is found to remain at a very low value for the same type of joint on similarly constructed cables. For example, in the Pren range of aircraft cables, 5/6 mV has been specified as maximum acceptable volt drop for all sizes from 4 to 280 A measured when passing full rated current.

Possible applications of these methods of conductor jointing in the future are considerable but more research and development is necessary for their exploitation. Work is in hand on a material and method for retaining both conductor and insulation of plastic covered cables under extreme temperature and vibration conditions, although satisfactory indent joints have been made with plastic covered sleeves. For electric pyrometry a pressure joint method for constantan, chromel, alumel, etc., is needed to keep the resistance changes to the low values permissible in thermo-couple circuits. More experience of long-term corrosion effects and tests with various inhibitors is necessary and of the effect of long exposure to extremes and rapid changes of temperature, particularly with mixed metals for conductor and termination. An improvement is possible in aluminium cable joints by making additional compressions and experiments are in hand to decide the optimum number, correct orientation and order of application: also being worked at is a satisfactory method of jointing solid conductors such as heater element materials.

A small initial investment in good tools and the use of correctly designed cable fittings has proved an insurance against future failures which may prove costly. It should be remembered that an electrical circuit is no better than its poorest connection.

Fuel Efficiency Exhibition

THE products and methods of nearly 100 manufacturers and organizations will be displayed at the third Fuel Efficiency Exhibition, to be held at the City Hall, Manchester, from 12th to 22nd October next. Unlike its predecessors, the exhibition will be devoted exclusively to industry. The Atomic Energy Authority will show the strides already made towards the industrial application of nuclear power and the Central Electricity Authority will demonstrate how the newest methods of fuel efficiency are applied in the generation of power.

WORLD ELECTRICAL MARKETS

Power Development in Pakistan

By ELIZABETH BALNEAVES

IN Pakistan, as with most underdeveloped nations, power is the key, not only to the ultimate industrial and economic stability of the country, but to the urgency of the immediate plans for raising the standards of living of its peoples. From the time of its inception in 1947 until the present, the political vicissitudes under which the country has been labouring have reflected most unfavourably on development policy in general, and particularly on power development. Indeed so vacillating have been the plans regarding its implementation that British suppliers have not surprisingly been inclined to concentrate on other, more certain, markets.

Restriction of imports because of Pakistan's grave lack of foreign exchange, prolonged delay in placing orders which have had to pass through the office of the Director General, Supply and Development, and narrow provincialism, have all seriously restricted a potentially valuable market. The entry of Continental firms into a field which hitherto had been almost exclusively British, and in which the main competitors in the electrical market are Germany and Italy, cannot be ignored. Sir George Nelson remarked upon this at the annual general meeting of the English Electric Co., which, with the A.E.I. group, has been responsible for most of the major power projects in Pakistan.

Co-ordination Proposals

An announcement in June last year that the Pakistan Government proposed to set up a separate organization to deal solely with electricity problems has given hope that at last some co-ordination will emerge and that a firm policy can be expected in the future. The General Electricity Commission, as it would be called, would be an advisory body to the Government and the precursor of a Power Development Corporation, an autonomous body invested with powers to put electrical development on a sound commercial basis. Last December it was further stated that as part of the development of West Pakistan as a single unit, it was proposed that major projects should be entrusted to a single organization to be known as the West Pakistan Power and Projects Authority. The first announcement was made nearly a year ago, but although H.G. Acres (Canada), the Italian firm of Montecatini, the British consultants Brian Colquhoun, International Engineering and a two-man commission from the Central Electricity Authority, have all prepared reports and suggestions an overall plan is still awaited.

Pakistan is primarily an agricultural country and can only support a semi-industrial economy dependent mainly on indigenous raw materials. Industrial expansion proceeds rapidly but the complementary power development has remained hopelessly inadequate. The president of the Pakistan Chamber of Commerce pointed out in January last that the main reason why Pakistan has not entered the jute goods export market on a larger scale is because electricity supply is inadequate and many looms are idle because of power shortage.

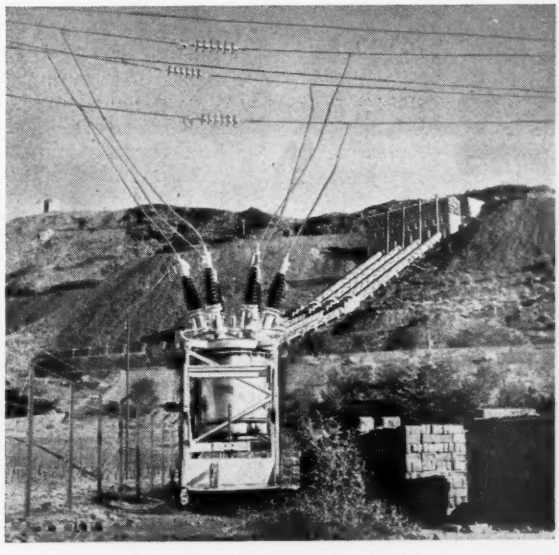
Producing only about one-sixth of its coal and oil requirements, the country vitally needs a cheap and easily available source of energy. In West Pakistan the North Western Railway with its 5,000 mile system is, apart from the United States, one of the largest consumers of oil fuel and diesel oil for traction purposes in the world, but so great are its overheads that it costs more to-day to bring a ton of cement from the works at Rohri to the port of Karachi than it would to ship it from London.

An outstanding recent event has been the discovery of natural gas at Sui in Baluchistan, and Pakistan has the distinction of being the first nation in Asia with active plans to put its natural gas resources to work as a major and cheaper source of fuel. Naturally this discovery has meant a complete revision of power projects.

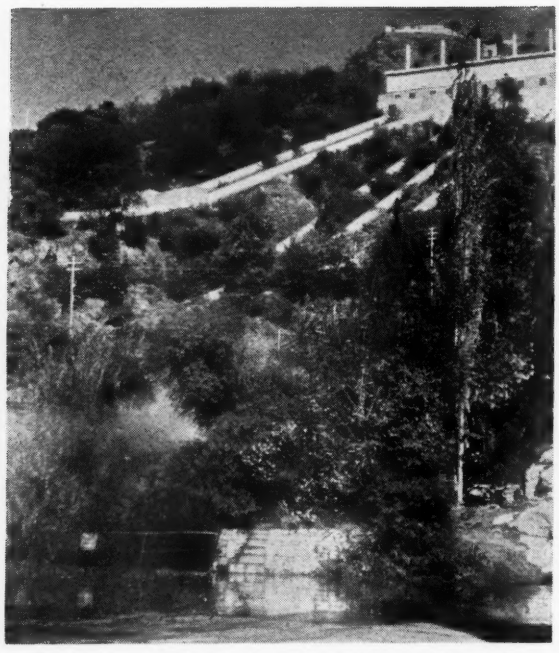
The pipe line from Sui to Karachi is scheduled for commission this month and will have connecting lines to electric power plants, cement works, cotton textile plants and other industries along its route. Nor will the task end when it reaches Karachi. Other schemes for using the gas, which has proved to be far in excess of the first conservative estimates, are under active consideration.

At the time of partition Pakistan had an installed power capacity of 71,458 kW which has now risen to 174,911 kW not including private industrial power plants. At the moment, however, in West Pakistan, with a population of 76 million, the number of consumers connected to the public utility systems is only 236,000 in an area of 365,000 square miles. In 1954 the 96 power stations had sales of 337 million kWh. East Pakistan is even more backward in development.

Although the intention is to develop West Pakistan as a single unit, a great deal of regional planning will still have to be undertaken and a zonal system of power supply worked out. The North West Frontier Province is rich



The Dargai hydro-electric undertaking



The Malakand station showing the valve house and penstocks

in potential water-power sites. One of the two main requirements of the province is adequate power to run the new industries which have sprung up around Nowshera, such as the D.D.T. and caustic soda plants, the antibiotics and pharmaceutical industries, woollen mills at Bannu and a textile mill at Charsadda. The number of large-scale industrial concerns now in production in the Province has increased to eleven and another thirteen major industrial projects are being established. The other essential, linked with that of power production, is a wider irrigation system, for the North West Frontier has a food deficit of about 50,000 tons annually.

Irrigation and Drainage

Economically, agriculturally and geographically, the Punjab is the heart of West Pakistan and the country's largest provincial unit, covering an area of over 63,000 square miles and supporting a population of nearly 19 million, second only in its density to that of East Pakistan. Agriculture is its main industry and over 80 per cent of the people cultivate the soil. From the Punjab comes the bulk of Pakistan's cotton and wheat crops. The Province has a total irrigated area of about 12 million acres. This extensive system of irrigation has unfortunately led to waterlogging over the past half century to such an extent that during the last ten years, 10,000 to 20,000 acres have had to be left out of cultivation every year and some 625,000 acres have gone out of cultivation altogether owing to excessive alkalinity, while a further wide area has been affected in varying degrees. Drainage by electrically driven pumping plant is vital therefore to reclaim the land, and there is ample opportunity for a comparatively cheap source of power from the low head falls on the Punjab's canal system. Textile mills, and chemical fertilizer and strawboard factories are being set up, while the Thal Project, expected to bring 1·5 million acres of land under eventual cultivation, of which 327,000 acres is already under the plough, embraces re-settlement and agriculture with industries interconnected with the project.

Baluchistan's future, to quote an expert's report, lies in livestock and wool production. Although offering no scope for "hydel" (hydro-electric) schemes of any kind, water is to be found reasonably near the surface, and tube-well drilling with suitable storage capacity could provide enough water for drinking and irrigation if power were available. There are no major industries.

Bahawalpur, one of the princely states which acceded to Pakistan at partition, is fighting mainly to reclaim land from the desert for the cultivation of crops and can be considered for our purpose in the same zonal region as Khairpur and Upper Sind, benefiting in irrigational facilities from the Sukkur Barrage on the Indus and in power from Sui gas.

Lower Sind embraces the Federal Capital area of Karachi which will be served directly by irrigation facilities from the newly opened Kotri Barrage across the Indus serving a total cultivable area of 2·8 million square miles, and indirectly by the formation of a lake fed from Kotri through the Kalri Baghair feeder. This lake, 45 sq miles in area, will afford an opportunity for the generation of electric power by the use of a 22ft fall giving 10,000 kW capacity, and it will act also as a reserve water supply for greater Karachi.

It will be readily appreciated from the foregoing therefore that power in Pakistan is inseparable from irrigation, embracing tubewells and lift irrigation, which accounts for the predominating number of multi-purpose schemes either in operation or under consideration.

Adhering to the zonal point of view, the Government has under consideration various major development projects in West Pakistan. In the N.W.F.P. the Warsak hydro-electric scheme, on the Kabul River 19 miles north-west of Peshawar, would besides the generation of electricity to which the North Punjab is also looking for supplementary energy, irrigate 120,000 acres of cultivable land in the Peshawar District and the tribal area. Power from Warsak would be used too to supply the needs of industry which is actively exploiting the mineral resources of this part of the country. The entire expenditure on this project with an installed capacity of 150,000 kW is to be met by Canada with a grant of $6·95 million which will meet the necessary electricity generating and related equipment, the provision of Canadian consulting engineers (H.G. Acres) for re-designing the project and supervision of construction of the dam, and the supply of a reasonable amount of Canadian manufactured light construction equipment to assist the Pakistan Government in construction work. The total cost of the project will be Rs.22·10 crores of which Rs.14 crores will be borne internally by Pakistan. The Khurram Gharri scheme, 5 miles from Bannu in the south of the province, for which the civil works are in hand with plant from Siemens of Germany, is mainly intended for lift irrigation but will also supply about 4,000 kW of electricity to meet the needs of Bannu and Dera Ismail Khan districts. Scheduled to go into commission this year it is not expected to prove economical for some time to come.

The North West Frontier Province, however, has always been one of the most progressive of the provinces and as an example the following table will serve to demonstrate the progress made during the last seven years:—

Description	Position before partition	Position in 1954
Transmission lines—		
66 kV double circuit	29 miles	29 miles
66 kV single circuit	79 "	162 "
33 kV	Nil	158 "
11 kV	233 "	433 "
132 kV	Nil	73 "
Number of towns electrified	4	20
Number of villages electrified	74	226
Number of consumers	9,800	46,000
Net revenue	Rs. 1,396,000	Rs. 2,613,000

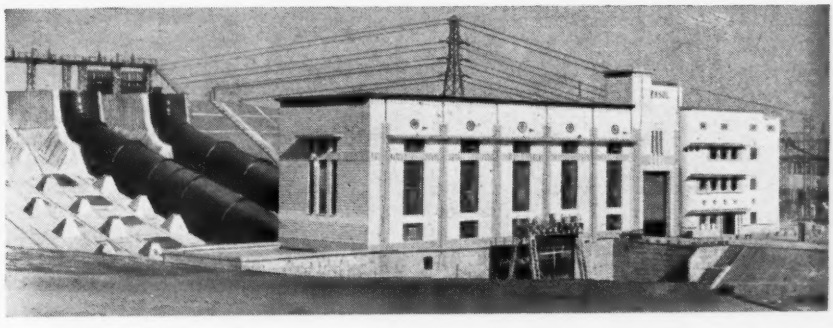
At present the Frontier's main supply of energy comes from the hydro-electric station at Malakand, increased in capacity in 1952 by the addition of two machines to 20,000 kW and with an additional 20,000 kW made available in 1954 from Dargai, an extension of the same project further down the valley. Although Dargai was intended to supplement power in the Punjab by linking up with the Punjab grid at Wah, it has not been possible to fully implement this, and in view of the rapidly growing industrial load it is expected that by the end of this year the entire output of both Malakand and Dargai will be consumed within the N.W.F.P. Unless some additional source of power can be brought into operation before the end of 1956, the resources of the province will be severely strained, for Warsak, even with the most rapid progress, can scarcely be commissioned before 1959 or 1960.

A suggestion to further increase the power available from the Upper Swat Canal at Malakand, where considerable head is lost because the original tunnel was designed solely for irrigation purposes, to the extent of about 17,000 kW of firm capacity and about 13,000 kW of seasonal power, has, I understand, been rejected. An investigation into the power potential which could be developed from the Kunhar River, a tributary of the Kabul in Chitral, is under consideration. In the first stage this could generate about 200,000 kW with an ultimate capacity of 1 million kW. The proposal to install a diesel generating station at Peshawar with a capacity of 4,500 kW and to link up Daud Khel with the Punjab grid at Sarghoda is another measure which could undoubtedly help to relieve the coming tension.

Water Power in the Punjab

After partition the reorganization of future planning and the utilization of the existing sources of electrical power in the Punjab was one of the most tremendous tasks ever to face an engineering organization, for before partition the Uhl River scheme was the main source of electricity for the united Punjab. Orders had already been placed with the A.E.I. for the supply and erection of all plant for the hydro-electric station at Rasul, substations and transmission line material. In addition, as Rasul was primarily intended for tubewell irrigation, although owing to shortage of power it is now supplying general industrial and domestic needs, the Government had also negotiated a contract with this company for the supply of 360 outdoor type transformers for stepping down power to drive groups of tubewells, as well as electric motors and starters and other equipment necessary for the installation of tubewells. The power station went into operation in mid-1952 with a maximum steady supply for six months of the year of approximately 22,000 kW, but during the winter when the availability of water is at its minimum, the station can only provide about 11,000 kW.

Further hydro-electric schemes designed specifically for the provision of sufficient cheap electricity for tubewell irrigation are under consideration and the civil works are in hand for Chichoki-Mallian and Shadiwal, each with a proposed installed capacity of 12,000 kW. The first of these, Chichoki-Mallian, has been negotiated by Jugoslavia under a barter agreement, while Canada, under the Colombo Plan, is providing plant for Shadiwal at a cost of $3·5 million. American pumping plant with Bloemenstein tubewell irrigation is understood to have been decided upon. In addition a multi-purpose power and irrigation project with an easily available generating capacity of 45,000 kW awaits exploitation where the Upper Jhelum takes off from the river near the village of Mangla. A storage reservoir with a capacity of 75,000 acre-feet for irrigation purposes would be a valuable feature of the scheme. One of the main objects of the project would be to supply cheap power for the operation of tubewells of which over 3,000 are projected for 1955-56. It is hoped in Pakistani circles that the feasibility and economy of the scheme will attract outside financial and engineering assistance.



Rasul power station in the Punjab

Other Sites

Another potential hydro-electric site lies at Khanki which could energize tubewells and provide irrigation for 5,000 acres in the head reach of the Lower Chenab Canal where likewise there are already in existence road and rail facilities as well as buildings for offices, etc. An investigation proposes the utilization of the headworks at Khanki across the Chenab River, built in 1892, with a total installed capacity of 8,176 kW in four sets. Shadiwal could then be extended for connecting Khanki power station with Shadiwal substation to bring Khanki on to the grid.

In the south of the province orders have been placed for plant for diesel stations of 10,000 kW each at Lyallpur with two additional secondhand steam turbine sets, while in Montgomery two 3,000 kW Japanese steam turbines with boiler plant are being installed. A thermal generating set is also being considered for Sarghoda and Sialkot, the latter being the centre of the surgical and sports goods industries. A hydro-electric site at Mianwali in the west of the province, although approved in 1953 by the Central Engineering Authority and with a proposed capacity of 100,000 kW, has now I gather little chance of being developed. Sufficient water will be available for the 120,000 kW steam station at Kot Adu on the bank of the Indus from the Taunsa Barrage, for which Pakistan has received aid under F.O.A. and which is scheduled for completion in 1958. Kot Adu, however, was first selected as the goal of the northern part of the Sui pipe line, with a steam turbine plant of 100,000 kW in view mainly of the projected pilot steelworks to be undertaken by Krupps.

Sind-Khairpur, that is Upper Sind, will probably be fed by a 33 kV line from Sui with a gas-fired thermal plant at Sukkur of 75,000 kW, while a similar plant at Kotri would go a long way to increasing the prosperity of this somewhat neglected part of the country. Although Hyderabad is the capital of Sind and site of an ambitious new university centre, besides a proposed cement factory and other industries and is within easy reach of the Sui pipe line, electrical development will have to be considerably speeded up in order to meet coming requirements. Tenders for the Hyderabad thermal station were opened

in 1952 and orders for plant were placed in November of that year, but no work on manufacture of machinery has been started as arrangements for finance have not yet been completed.

The Federal Capital area consisting of Karachi city and cantonments and what was previously part of Karachi district, covers an area of 812 square miles. The population, now well over a million, has increased by nearly 158 per cent since the 1941 census. In 1953 the production of electricity in Karachi had registered an increase of 67 per cent over 1950, while the additional capital estimated for expenditure from October, 1954, to December, 1956, to enable the Corporation to carry out urgent additional extensions for which most of the plant and equipment has been already ordered, was estimated at Rs.55·3 million. The transmission and distribution system feeding the area has been remodelled and the construction of an additional thermal station of 60,000 kW capacity is contemplated at Landi in addition to station "B" consisting of two 15,000 kW sets now nearing completion.

Position in East Pakistan

East Pakistan, separated as it is from the west by 1,000 miles of Indian territory, presents a complex problem. One of the most densely populated areas in the world, before Partition it was essentially an agricultural province, growing mainly jute and rice. The rapid industrialization of East Bengal has resulted in the concentration of tens of thousands of workers in different industrial areas and a complete new programme of power development has had to be instituted. The main source of energy in the south will be the multi-purpose project situated on the Karnafuli River which rises in the Chittagong hill tracts and on whose bank lies the fast developing port of Chittagong itself. Karnafuli Paper Mills, the first of its kind in Pakistan, commenced production in 1953 and along with an 86,800 ton sheet and tin mill in Chittagong, demand a great amount of energy. F.O.A. has lent the services of the International Engineering Co. to advise the Government on the Karnafuli project for which the preliminary works have been completed and an ultimate generating capacity of 160,000 kW is contemplated. This company is at the same time undertaking a power survey of East Bengal. Canada, in addition to her commitment in connection with the Warsak scheme, has also given aid for a power station of 10,000 kW included in the Ganges-Kobadek scheme in the Khulna district in the south-east of the province, the first phase of which is expected to be completed in 1955-56. Civil work, however, is only now being started on the Sidhirganj 30,000 kW steam station, while the diesel station which is to have an eventual capacity of 15,000 kW has not reached anything like that figure yet.

Trade Prospects

It is difficult to predict the overall plan for the next five years; much will depend on Pakistan's ability to maintain a stable government, but certainly there will be big extensions to the present system. At the moment the real need is for technical services and advice, and a determination on the part of whatever body comes into being for the development of power resources to follow a balanced, pre-conceived plan, together with careful integration of the existing hydro-electric and thermal stations, the developments contingent on the supply of gas from Sui, and future hydro-electric installations.

Little or no indigenous manufacture of electrical material exists although factories are producing electric lamps, small switchgear and motors, Bakelite lighting fittings (allied to the plastics industry), fans and cables. It is obvious, therefore, that local manufacture will be able to supply only a small fraction of the required industrial and domestic electrical apparatus if the projected schemes are put into operation. The market will be an attractive one and representatives of British concerns in the country with whom I have discussed the situation, are, in general, of the firm conviction that before ten years are up, although at present prospects appear somewhat gloomy, if our present position is maintained, we should be in a highly favourable position to take advantage of the undoubted opportunities which will arise for expanding British trade in Pakistan.

Nuclear Energy Developments

AT the Institution of Civil Engineers last week Sir John Cockcroft, director of the Atomic Energy Research Establishment, Harwell, delivered the James Forrest Lecture. According to *The Times*, Sir John disclosed that an additional reactor for testing materials and components was being built at Harwell, and mentioned a number of reactor types which would repay study. As well as the experimental heavy water reactor, E.443, which is under construction, Sir John mentioned a further heavy water reactor which would give extended facilities for testing materials. It would provide some eight "loops," through which materials could be passed under controlled conditions of temperature and radiation. It would be known as RE.773.

A problem which was being studied in an existing reactor was that of chemical reaction between the carbon dioxide used in cooling the present British type of power reactor and the graphite blocks used in its operation. Such reaction increased rapidly with radiation intensity, and up to 50 such projects could be identified in the development of a single type of reactor.

Passing to possible "stage 2" reactors, he said that they were carrying out a design study at Harwell on a reactor moderated with light water instead of with graphite blocks. As materials for the sheathing of the uranium rods there was a choice between stainless steel and an alloy of zirconium; but stainless steel would be bad for fuel economy unless it could be used in thin-walled tubes, and the use of zirconium of the required purity would add about 0·03d/kWh to generating costs.

Among other types which would repay study, Sir John mentioned the liquid sodium cooled, graphite moderated reactor, and the so-called homogeneous reactor through which the nuclear fuel was circulated in solution. All these were types which were being tried in the U.S.A., and with the homogeneous reactor it should be possible to "breed" from thorium. There was an exacting demand for freedom from leaks since the material circulated was highly radioactive and highly corrosive.

The experimental "fast breeder" reactor, to be built at Dounreay, he described as the physicist's dream, but to some extent the engineer's nightmare, the required rate of extraction of heat from a given weight of material being perhaps 100 times as great as in the most highly rated boiler.

Possibilities in Uruguay

By C. B. B. HEATHCOTE-SMITH*

URUGUAY is a small country, little larger than England and Wales together. The population is estimated at nearly 3 millions. The country is advanced socially and the use of electricity well developed. Electric light and power is now a monopoly of the State. The following table shows electricity consumption in the years 1951-1953:—

	1951	1952	1953
Number of consumers	380,728	405,121	429,324
kWh generated (million)	681·6	752·9	844·8
kWh per inhabitant	208·3	224·0	238·6
Energy consumed by commerce and industry (million kWh)	263·2	281·3	326·7

The first public electric light service in Montevideo was installed in 1861 by private interests. In 1906 the State took over the Montevideo power station and a complete transformation was carried out. The distribution networks were placed underground and the transformers housed in substations. A new electric power plant was inaugurated in 1909, supplying three-phase a.c. at 50 c/s and 220 V.

In 1912 the Uruguayan Government formally established a state monopoly of electric power. In 1931 the telephone service was also nationalized and the public corporation now controlling electricity and telephones is called the Administración General de las Usinas Eléctricas y los Telefonos del Estado, known locally as the "U.T.E."

The "Jose Batlle y Ordoñez" thermo-electric power station was constructed in 1930, with a capacity of 50,000 kW, now being expanded by 100,000 kW. The machinery and equipment was British (Metropolitan-Vickers turbo-alternators, with Babcock & Wilcox boilers), but unfortunately the recent contract for the 100,000 kW extension was obtained in public tender by a French group. They are installing German Babcock & Wilcox boilers and equipment and two 50,000 kW Brown-Boveri turbo-alternators. An earlier station now serves as a standby for emergencies, but because of outworn equipment its effective capacity is only 30,000 kW.

Uruguay has no indigenous fuel supplies; all coal and oil has to be imported and she is anxious therefore to make the best use of hydro-electric resources. The principal hydro-electric plant is that at Rincon del Bonete on the Rio Negro, just above the town of Paso de los Toros, more or less in the centre of the Republic and about 165 miles from Montevideo by road. The building of the dam created an artificial lake 87 miles long by 18 miles wide. In 1937 the contract was awarded to a consortium of German firms, headed by Siemens, but as a result of the outbreak of the second world war work practically ceased. Finally an arrangement was made with the Westinghouse Electric Corporation, United States, to complete the work. The first turbo-alternator unit was put into operation in 1945 and the second in 1947. In 1948 the installation was completed with the third and fourth units and the total installed capacity of the station is now 128,000 kW. The Rincon del Bonete hydro-electric plant is connected with Montevideo by a h.v. transmission line.

Since the war the consumption of electricity has steadily increased and is now well over double what it was in 1946. Rincon del Bonete supplies about three-quarters of the electricity consumed in Montevideo, though in years of water shortage this proportion may decrease. About 90 per cent of the total electricity supply in the country is consumed in Montevideo.

The U.T.E. estimates that power consumption will steadily increase from the figure of approximately 850 million kWh in 1954 to 1,400 million by 1960 and 3,030 million in 1970. To meet the growing demand new sources of electric power are therefore planned.

For some years consideration of a further hydro-electric station at Rincon de Baygorria, a point on the Rio Negro

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The title picture shows the principal establishments of the "U.T.E.," Montevideo. Left: The Ing. Santiago Calcagno steam power plant. Centre foreground: Fuel oil tanks and general workshops. Centre background: General warehouse and administration building. Right: The Jose Batlle power station

below the Rincon del Bonete, has been under study. In 1951 an agreement was signed for a loan from the International Bank for Reconstruction and Development totalling U.S.$33 million, to cover various projects, including the extension of the Montevideo thermo-electric power station, and the construction of a hydro-electric station at Rincon de Baygorria. Tenders for the latter project, the cost of which will be in the neighbourhood of £4 million for the electrical equipment alone, have been received. Two British firms, and a number of other foreign firms (including French, German, American, Japanese and Austrian) presented offers.

With the construction of Rincon de Baygorria the power situation will be as shown below. It is estimated that it should meet electricity demands up to 1959 at least.

	Normal Capacity (kW)	
Rincon del Bonete	108,000	141,000 kW (under dry weather conditions)
Rincon de Baygorria	87,000	
Jose Batlle y Ordoñez	45,000	
Two new units	100,000	
Available power	340,000	

The total cost of all projects, which call for considerable capital investment for the purchase of machinery and equipment abroad, is conservatively estimated at 150 million pesos (£17 million), including 113 million pesos (£13 million) for Rincon de Baygorria. Besides the extension to the power station in Montevideo, work is well advanced on the two distribution networks known as the Western and Eastern Circuits respectively. The object of these two circuits is to incorporate into the Montevideo-Rincon del Bonete system other towns at present served by local diesel-electric plants.

The Western Circuit consists of 452 miles of overhead transmission lines covering the western and south western areas of the Republic. The Eastern Circuit comprises a total of 87 miles of transmission lines. It supplies electricity to the south eastern corner of Uruguay which includes the popular seaside resorts of Piriapolis and Punta del Este and the interior town of Minas.

Work is almost complete on the new primary distribution system of 31·5 kV for Montevideo, which has been designed on the most modern lines of radial instead of mesh distribution. The development of the electric power supply for other towns in the interior, including conversion to 220 V a.c., is also planned. The capacity of a number of power stations is to be increased, and some new stations are to be built. Completing this extensive programme, reference must be made to the Melo-Treinta y Tres-J.P. Varela circuit, which is to supply electric power to three towns in the north east, power being drawn from a hydro-electric plant and a new thermo-electric station.

A further hydro-electric plant on the Rio Negro below Rincon de Baygorria is already being considered, and a new 500,000 kW thermo-electric station in Montevideo is contemplated. The plan for a joint Uruguayan-Argentine hydro-electric plant on the Uruguay River at Salto Grande (near the Uruguayan town of Salto) may also be revived.

The Montevideo municipal transport undertaking "AMDET" is replacing its tramways by trolley-buses. The original order for 18 of these vehicles went to the United Kingdom but a further order for 250 went to Italy. Trolley-buses are now rapidly replacing the trams.

The State Railways Administration (AFE) is substituting diesel for steam locomotives; 63 diesel locomotives have been purchased in the United States since 1949.

There is no industry in Uruguay for the manufacture of electric generators, motors, transformers, rectifiers, etc. Electrical measuring instruments are all imported. Certain types of light electric cables and wires are manufactured locally, but power transmission, lead-covered and armoured cables are all imported.

There is, however, a considerable and growing local industry, protected by high tariffs and restrictive import quotas, covering the manufacture or local assembly of domestic electrical apparatus of all types. Electric lamps for domestic use are manufactured locally, satisfying the greater part of the demand, higher wattages and spare parts being imported. There is local manufacture of electric irons, kettles, toasters, etc., in some cases using imported components. Imports of these appliances are increasingly restricted but they are generally preferred to the local product because of their better quality.

Electric cookers of simple type are made locally and fairly cheaply. More elaborate cookers are now being assembled from imported components, the bodies being made locally. Other electrical appliances such as water heaters, washing machines, etc., are now assembled in Uruguay from imported components; some parts are of local manufacture. A number of well-known British and foreign firms market their goods in this way and competition is increasingly keen. Electrical accessories and

The Rincon del Bonete hydro-electric plant

fittings are manufactured in the country, and imports are negligible owing to restrictions.

Units for domestic refrigerators are imported, but the cabinet and motor assembly work is done locally; large types of refrigerators for commercial establishments, restaurants, etc., similarly consist of imported units and locally made cabinets. Several well-known international concerns, including British firms, have arranged for local assembly and manufacture of parts of refrigerators.

Radio sets are to an increasing extent being manufactured locally and very little exchange is made available for import of complete sets. While many components have to be imported to an increasing extent they are also being manufactured locally. A large number of types of radio valves are now made in Uruguay by General Electric S.A., a branch of the International General Electric Corporation of New York. There are about 20 commercial broadcasting stations in Montevideo and another 20 in interior towns. There is no television as yet in Uruguay, but the State Broadcasting Service has called for tenders for the supply of a television station.

All imports are controlled by the Export and Import Control Board. Import quotas are opened at irregular intervals according to the availability of exchange. So-called less essential goods have been increasingly restricted in recent years to give protection to local industry.

The procedure regarding imports is that when a quota is announced, import permits are distributed among importers according to a system of points, which is based on their previous imports, capital employed, wages paid, number of employees, etc. The system is complicated and slow-moving.

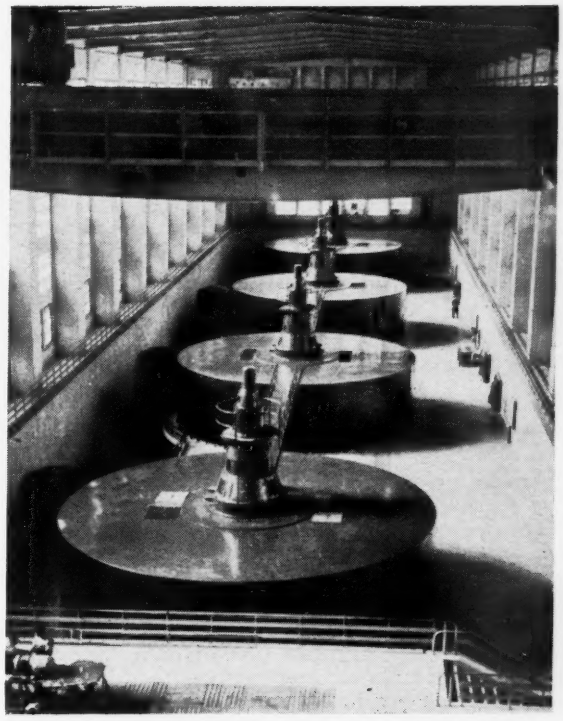
Owing to the delay in publishing official statistics, detailed figures are not available beyond 1952. In that year, out of a total of U.S.$5,304,053 for electrical goods, the following were the principal items imported:—

Description	Quantity	Value
		U.S.$
(1) Electrical apparatus such as fans, beaters, juice extractors, hair dryers, toasters, etc.	117,813 kg	538,594
(2) Cables and flexes	296,319 kg	301,528
(3) Electrical generators and motors, etc.	3,210 units	976,515
(4) Electrical measuring instruments ...	5,606 units	113,261
(5) Accessories for electrical installations, switches, plugs and sockets, bells, etc.	122,219 kg	105,531
(6) Telephonic and telegraphic equipment	313,105 kg	826,208
(7) Transformers, double throw switches, condensers, rectifiers, control elements for switchboards, motor starters, etc.	73,716 units	5,176,439
(8) Accessories and spares in general with the exception of those under (5)	113,153 kg	205,336
(9) Armoured cables and accessories ...	1,441,555 kg	965,848
(10) Electric cookers in general	2,097 units	105,242

(1) The chief supplier was the United States with U.S.$297,000 followed by Germany and the United Kingdom with $78,000 and $61,000 respectively. (2) Germany with $110,000 was the chief supplier with Italy following with $103,000. (3) United States with $618,000, followed by United Kingdom, France and Germany with $136,000, $110,000 and $102,000, respectively, were the chief suppliers. (4) Germany was the outstanding supplier ($81,000). (5) Germany supplied $54,000 of this amount. (6) Germany led with $535,000 with Belgium, United Kingdom and United States between $71,000 and $50,000 each in that order. (7) Italy was chief supplier with $186,000 followed by United States, Belgium and United Kingdom with $110,000, $102,000 and $101,000, respectively. (8) United Kingdom $98,000 and Germany $23,000. (9) Holland supplied $649,000 and United Kingdom $210,000. (10) Germany led with $40,000.

In 1952 the principal supplying countries were the United States $1,285,747, Germany $1,254,270, Holland $709,910, United Kingdom $707,067, Italy $401,798, Sweden $246,924, Belgium $218,845, France $144,526, Switzerland $91,760, Japan $31,515, Czechoslovakia $28,562, Denmark $28,471 and Canada $22,076.

The years 1952 and 1953 were relatively bad for the United Kingdom but owing to greater availability of sterling in 1954, United Kingdom imports into Uruguay were probably better.



Interior of the Rincon del Bonete station

For the purpose of comparison and to show the trend since 1952, the following figures of total electrical imports are of interest:—1952 $5,304,053, 1953 $9,880,000 and 1954 (first five months) $3,593,000.

The Uruguayan market is best covered by the appointment of an agent. A substantial part of the importing business in Uruguay is in the hands of large merchant houses in Montevideo, and representation by one of these firms is often the best way of doing business.

It is particularly important to have a local representative because the greatest part of the potential business in electrical machinery is with the U.T.E., and all tenders submitted for Government contracts have to be presented through a properly appointed local agent. The other Uruguayan Government Departments and Ministries, and autonomous entities such as the State-owned railways are also important clients. An intelligent local agent can understand the ever-changing and complex import and export control regulations.

Competition in electrical machinery and goods is extremely keen, especially from Germany, the United States, France and Italy. It is also important that firms wishing to trade in the Uruguayan market should prepare their catalogues and their trade literature in Spanish. The complaint is frequently heard that British trade literature is inferior to the German and American in this respect. British firms should also ensure that they quote prices in a way intelligible to the Uruguayan importer, preferably c.i.f., and with weights and measures expressed in metric equivalents. It must be remembered that Uruguay has been able to buy relatively freely from all over the world since the war, and the Uruguayan is as a result a discriminating and critical customer, with a taste for the most modern. Appearance as well as quality is of considerable importance.

In 1953 and 1954 the United Kingdom was Uruguay's best customer and although Anglo-Uruguayan trade is

subject to fluctuations, prospects are generally favourable. The extensive development programme of the U.T.E. means that there is a large market for generating plant, transformers, transmission lines and cables, meters, etc., as well as a wide range of telephone equipment. All these requirements are put out to public tender.

There is a considerable local demand from the rural districts, for battery charging units, both motor and wind driven. The popular voltages are 6, 12 and 32. There being no heavy industry, the demand for electric motors is mainly for the smaller horse powers, but it is a good and expanding market.

The market for domestic electrical goods is increasingly restricted because of local manufacture, but it is still considerable. Manufacturers should, however, be ready to consider the possibility of local assembly.

LETTERS TO THE EDITOR

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for the opinions expressed by correspondents.

Freedom of Expression

IN his recent letter to you (*Electrical Review*, 20th May) Mr. J. K. Wilkins speaks of the "very pointed reluctance" of L.E.B. delegates to support the papers read at the E.D.A. Sales Conference, and he proceeds to make the astonishing statement that "it is a sad state of affairs when staffs feel that freedom of expression at conferences will probably retard careers and promotion in any future reorganization." An analysis of the speeches made at this Conference shows that there were five other Boards whose delegates made fewer speeches than the delegates from London, and presumably those Boards are even more deserving of Mr. Wilkins' strictures. Your correspondent does not mention that he himself spoke three times at the Conference and did so without any let or hindrance.

The fact that delegates may not choose to speak in support of any particular paper is, of course, no argument that the Board does not support, or shows any reluctance in supporting, the promises advocated. But the main aspect of Mr. Wilkins' comments is the quite untrue—and therefore malicious and disloyal—suggestion that employees of the Board who take part in conferences of this nature are covertly punished by the Board for doing so, and I feel that Mr. Wilkins has "let down" his own Board and his own colleagues.

With regard to the leading article in your issue of 6th May, I would suggest that people in our industry should have and do have freedom to express their views, both verbally and in print, on a wide range of subjects, but they must show discrimination. One does not expect men and women who hold responsible positions to criticize in public policies decided upon by the organizations which employ them. Thus an official of an Area Board should be able to discuss every aspect of electrical development but he ought not publicly to condemn, say, the tariff policy of his Board. Similarly, a generating engineer should be free to talk of fuel efficiency but not publicly to condemn the Central Authority on a matter which is entirely its responsibility. In our industry there is, I believe, considerable latitude given to people to express their views, and fortunately most of those people realize the difference between good sense and bad taste.

London, E.C.2. H. J. RANDALL,
Chairman,
London Electricity Board.

Modern Meter Testing

YOUR correspondent, Mr. C. H. Forster (*Electrical Review*, 6th May), does not appear fully to have appreciated the significance of the stroboscope/counter method of testing. I agree that a "mixed bag" is unusual, but the ability very quickly to match the substandard speed to that of any batch of meters and to make allowances for curve and cover, all by manipulation of four decade switches, is, I can assure him, very valuable.

The counters are not in any way involved with mains frequency. Their speed is locked to that of the rotating substandard, and the counters are effectively slave dials thereof. I do not recall suggesting a reduction of the low load test to less than one disc revolution.

I see no objection at all to the American method of testing meter registers mechanically so far as modern meters are concerned. There are now virtually only two kinds of register per manufacturer, and so far as I can ascertain, all register gears are now checked through a gate box. It is agreed that the Meters Act regulations now require an electrical dial test, but I suggest that the Meters Act is out of date in so doing.

Whilst writing, I have heard that my statement that a tester tested 750 meters single-handed in one week has come as somewhat of a shock in certain quarters. The meters concerned were all new ones, and the tester used twenty counters simultaneously. The 400 per cent improvement of output to which I referred is a comparison over a twelve-month period between the test room productivity of a testing station having this modern equipment against that of another station of comparable size using older methods.

London, S.E.1. H. S. PETCH.

Preserving Rural England

IN its annual report for 1954-55 the Council for the Preservation of Rural England has much to say about electricity distribution to country areas. It says that "overhead lines are being erected everywhere, in many cases with deplorable results to the landscape amenities of rural districts . . . . The Area Boards appear to be a law unto themselves in these matters but the time has surely come for some sort of policy settlement on a 'national' basis." Particular reference is made to the proposals of the North Western Electricity Board to erect overhead lines in Borrowdale and Deepdale (Ullswater). The Council says that the Board has been very properly concerned to make the supplies available at as cheap a rate as possible, but in doing so has "displayed a quite inadequate interest" in the effect which the lines might have on the appearance of the countryside. "There are cases where the extra expense involved [of laying underground cables] should be incurred by the Nationalized industry in the interest of the nation as a whole and the C.P.R.E. submit that this is one of them."

Several other overhead-line proposals are mentioned and the report then deals with the North Wales hydro-electric schemes of the Central Electricity Authority. It is shown that several points raised by objectors were conceded by the C.E.A. although the petitioners did not obtain all they asked for.

VIEWS on the NEWS

By REFLECTOR

A FALL in the domestic consumption of gas has been attributed by a West Midlands Gas Board official to a number of reasons. He said that because of the expansion of factory canteens and school meal services there was now less cooking at home and, moreover, the cooked breakfast was diminishing in popularity. Less washing was now being done domestically on account of the growing use of the "launderette" system. There have been other indications of a decline in the use of gas and in the sale of gas appliances recently. So far as I can gather the electrical industry is not having the same sad experience. This leads me to wonder whether the gas people have not overlooked one possible major factor. It is true that the Gas Board official mentioned the possible effects upon the gas industry of electricity produced from atomic power but he put the danger as "many years ahead."

* * *

As I understand it, the Associate class of the Institution of Electrical Engineers is for those who have not the technical qualifications for corporate membership. The policy of the I.E.E. seems to be to take every care that the designation "electrical engineer" is restricted to those who have qualified. How then does this square with I.E.E. Bye-law 14, relating to Associates, which provides that an Associate must have had at least five years' experience in a responsible position as an *electrical engineer*?

* * *

Protests continue to appear in *The Times* about the alleged ruining of Lakeland scenery by electricity supply lines. One was from the chairman of the Friends of the Lake District who said that the mileage of underground cables now required for the Borrowdale and Patterdale supplies (in addition to the underground sections already agreed to by the North Western Electricity Board) was under five miles. He put the cost of this at £5,000 which was only a "bagatelle" against the Board's normal annual extensions. He concluded by asking

> "If the most powerful electricity board in the country jibs at £5,000 of extra cost in one year in a national park, why did the nation nationalize its electricity supply?"

There were others reasons, of course. By the way the description "most powerful electricity board" will not go undisputed.

* * *

Over a million dollars a year is spent by the Cleveland (Ohio) Electric Illuminating Co. in keeping trees from interfering with the 44,000 miles of lines in its 1,700 square mile service area. The work is contracted out (says the *Electrical World*) to private tree surgeons and nurserymen. Much trouble is experienced in obtaining owners' permission to trim their trees. In an endeavour to reduce the trouble and expense the company has inaugurated a free tree-planning service which it is offering to the 137 incorporated communities in this area. This plan covers the selection of types of tree that are calculated to grow in such a way as to give little trouble in the future and their spacing with the same object in view. One thing the company is trying to stop is the planting of silver maples and American elms which are quick spreading growers with brittle branches that easily snap off in high winds and foul power lines. The recommended trees, most of which so far as I know are not often seen in this country, are flowering dogwood, sassafras, Chinese scholar tree, zelkova, golden rain tree, flowering crab apple, little-leaf linden, Paul's scarlet hawthorn, columnar sugar maple, Armstrong red maple and whitebeam mountain ash.

* * *

Writing on last week's Chelsea Flower Show the Horticultural Correspondent of *The Times* dealt with the great interest taken nowadays in the equipment side of such shows. He said:—

> "Perhaps most significant of all is the influence of electricity upon our gardening. Automatic electric heating of greenhouses is now at a state of efficiency which encourages more and more gardeners to try their hand at greenhouse plants, thus opening up wider and more interesting possibilities."

These possibilities also extend to the installation of equipment. In the circumstances usual in such cases it is imperative that installations shall be done properly and safely and enterprising contractors should be able to build up a useful side-line from this class of work if they go out for it.

* * *

With a new Parliament about to assemble it may be appropriate to quote some remarks made in the *Electrical Review* sixty years ago about the new Speaker Dr. W. C. Gully (later Viscount Selby). The issue of 7th June, 1895, said that Dr. Gully exerted an extraordinary influence upon everyone with whom he came into contact. He attributed this to the possession of "wonderful electrical powers." An attempt to explain this was made in the *Weekly Dispatch* which is quoted as saying:—

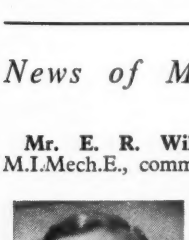
> "Our readers are doubtless aware that a magnet or needle has positive electricity at one end and negative electricity at the other. If the positive end of the magnet be brought near the positive end of another, they repel each other, and so do two negatives, but unlike ones attract one another. Dr. Gully's idea (in endeavouring to explain his wonderful powers) was that when persons charged with like electricity came near each other a feeling of repulsion was created, but persons of opposite electricity felt a liking for each other and this feeling was strong in proportion to the amount of electricity with which they were charged."

The *Review* hoped that the new Speaker would use his wonderful powers in the House.

PERSONAL AND SOCIAL

News of Men and Women of the Industry

Mr. E. R. Wilkinson, M.I.E.E., M.I.Mech.E., commercial manager of the Central Electricity Authority, has completed his mission on behalf of the International Bank for Reconstruction and Development and was due at Southampton in the *Mauretania* yesterday (Thursday). At the request of the Government, the Central Electricity Authority agreed to second Mr. Wilkinson to the World Bank early last year to undertake this mission in connection with the development and capital requirements of the electricity supply industry of Mexico during the next ten years.



Mr. E. R. Wilkinson

The Electric Construction Company, Ltd., announces the appointment of **Mr. A. N. D. Kerr,** A.M.I.E.E., as its district engineer in Bristol, for the counties of Gloucester, Hereford and Somerset. After a sandwich course of training at the Northampton Engineering College, Mr. Kerr gained experience with the A.E.G. and Crompton Parkinson, Ltd. Later he was London manager for the Electrical Power Engineering Co. (Birmingham), Ltd., and in 1953 became London sales manager for Newman Industries, Ltd. During the war he commanded a mobile workshop overseas and was twice mentioned in despatches. He is a past president of the Old N'ions and has served on the A.S.E.E. Executive Council.

As a result of last week's General Election there was one addition to the electrical representation in the House of Commons, Mr. R. L. Mawby, a member of the Electrical Trades Union, being elected for Totnes, where he stood as a Conservative candidate. All the "electrical" ex-members were re-elected: Sir William Darling (C., Edinburgh, South), chairman, Bruce Peebles & Co., Ltd.; Mr. F. J. Erroll, A.M.I.E.E. (C., Altrincham and Sale), formerly Parliamentary contributor to the *Electrical Review*; the Hon. J. Grimston (C., St. Albans), director, Enfield Rolling Mills, Ltd.; Mr. C. I. Orr-Ewing, O.B.E., A.M.I.E.E. (C., Hendon, North), A. C. Cossor, Ltd.; Mr. C. R. Hobson (Lab., Keighley), power station engineer; Mr. A. M. F. Palmer, A.M.I.E.E. (Lab., Cleveland), editor of the *Electrical Power Engineer* and Parliamentary contributor to the *Electrical Review*; Mr. H. Macdonald Steward (C., Stockport, South), works development engineer, British Insulated Callender's Cables, Ltd.; and the Rt. Hon. R. R. Stokes (Lab., Ipswich), chairman and managing director, Ransomes & Rapier, Ltd.

Mr. D. L. Anderson, C.B.E., took up his duties last month as chairman of the Federal Hydro-Electric Board of Rhodesia and Nyasaland. For the past two years Mr. Anderson has been Controller of the Colonial Development Corporation in Nyasaland, the Rhodesias, Bechuanaland and Swaziland. He is a civil engineer by profession and practised in Scotland and London from 1922 to 1939.

Mr. R. M. Robbins, B.A., secretary to the London Transport Executive, has been appointed chief public relations officer in succession to Mr. D. McKenna, who was recently appointed assistant general manager of the Southern Region, British Railways. He is to continue as secretary to the Executive.

Mr. T. C. Gilbert, M.I.E.E., whose article on "Earth Leakage Protection" appears in this issue, entered the electrical industry as an apprentice wireman and was later in business as an electrical contractor for many years. He was responsible for the introduction into this country of the voltage operated earth leakage circuit-breaker from Germany in 1929 and first demonstrated this to the Wiring Regulations Committee of the Institution of Electrical Engineers in 1930. He served with the Royal Engineers in the 1914-18 war and again from 1940 to 1945, and is at present managing director of a company manufacturing and marketing non-metallic electrical conduit systems and moulded accessories.

The Minister of Fuel and Power has appointed **Mr. E. J. Hunter,** of Stocksfield-on-Tyne, as a part-time member of the North Eastern Electricity Board as from 1st May, and **Mr. G. A. Nott,** of Tenbury Wells, Worcs, as a part-time member of the Midlands Electricity Board.

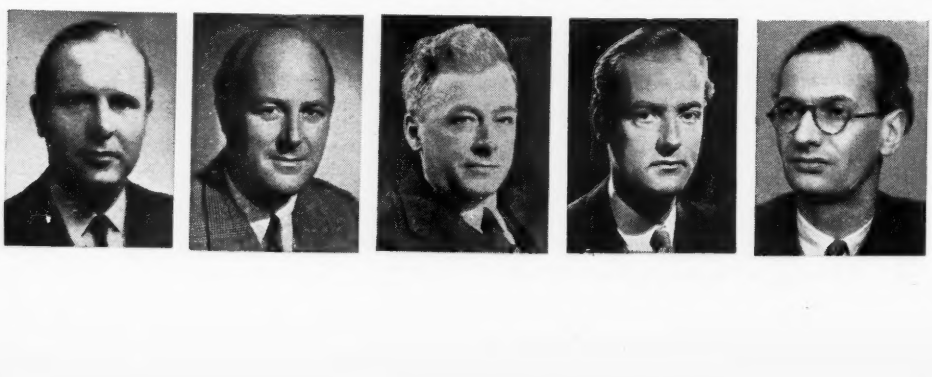
Mr. L. D. Gunnell, general sales manager, and **Mr. H. G. Carter,** A.C.A., secretary, have been appointed directors of Foster Electrical Supplies, Ltd.

Mr. L. D. Gunnell

The following officers have been elected by the London Students' Section of the Institution of Electrical Engineers for the 1955-56 session: Chairman, **Mr. M. H. F. Collins** (British Thomson-Houston Co., Ltd.); vice-chairman, **Mr. K. W. E. Gravett,** M.Sc.(Eng.) (Post Office Research Station, Dollis Hill); hon. secretary, **Mr. E. L. Jones,** B.Sc. (Edison Swan Electric Co., Ltd.).

Miss Nona M. Baker, M.B.E., has succeeded the late Miss Beth Card as branch development secretary of the Electrical Association for Women.

Holophane, Ltd., announces the following board rearrangements and appointments which will take effect on 1st July next:—**Mr. Guy Campbell** has resigned his position as joint managing director but will remain chairman of the company. **Dr. S. English** has resigned from his position as joint managing director and also as technical director but will remain on the board and has been appointed vice-chairman. **Mr. C. H. Bansback** (secretary) and **Mr. W. T. Souter** have



Left to right: Messrs. F. J. Erroll, J. Grimston, C. R. Hobson, C. I. Orr-Ewing and A. M. F. Palmer

been appointed joint managing directors and **Mr. J. G. Holmes** joins the board as technical director.

Birlec, Ltd., which has recently joined A.E.I., Ltd., has appointed **Mr. K. L. Moon** as sales manager of its induction heating division. Mr. A. E. Pickles continues as manager of the division, with overall responsibility, and Mr. R. Abbot as technical manager. **Mr. H. J. Podmore** has been appointed sales manager of the specialist dryer division. Mr. T. C. Sanders continues as manager, with overall responsibility, and Mr. J. W. Carter as technical manager of this division.

The following new appointments to its technical staff are announced by Sharples Centrifuges, Ltd.:—**Mr. R. T. Collins** has been appointed senior project engineer (Midlands), **Mr. G. H. Duffield,** A.M.I.Mech.E., has been appointed senior project engineer (Northern) and **Mr. M. W. Vincent,** B.Sc., A.R.I.C., will be especially concerned with all aspects of project development work in the "Tower House" laboratories at Stroud.

Mr. F. Short has resigned from the board of Ultra Electric (Holdings), Ltd.

The Southern Area finals of the **Electrical Industries National Golf Championship** will take place on 6th July at Highpost Golf Club, near Salisbury. The entrance fee is 5s and while entries will be accepted on the day it is preferable that they should be made in advance. Particulars can be obtained from the hon. secretary, Mr. L. G. Chittenden, Wall & Attwooll, Ltd., 157-159, New Road, Portsmouth.

OBITUARY

Mr. Geoffrey F. Falk, T.D., M.I.E.E., second son of the late Mr. Max Falk, and a director of Falk, Stadelmann & Co., Ltd., died suddenly on 24th May at the age of fifty-six. Mr. Falk was educated at University College School, Repton, and Faraday House. He was commissioned in 1918 in the Wiltshire Regiment and after the 1914-18 war served in the Territorial Army in the Manchester Regiment. On the outbreak of the last war he rejoined the Second London Divisional Signals, becoming lt.-colonel and C.S.O. of the South Eastern Command and Northumbrian District and B.A.O.R. Mr. Falk joined Falk, Stadelmann & Co. in 1922, was appointed a local director in 1943 and became a full director in 1947.

The late Mr. Geoffrey Falk

Mr. H. P. Rich.—The death occurred on 22nd May at the age of sixty-five of Mr. Harry P. Rich, managing director of Rich & Pattison (B'ham), Ltd. Mr. Rich had been associated with the company for the whole of his business life.

Mr. Albert E. Bone, of Benton, Newcastle-on-Tyne, a director of Watson-Norie, Ltd., electrical and mechanical engineers, Newcastle, has died at the age of sixty-four. Mr. Bone joined the company thirty-eight years ago.

Mr. James Paterson, former managing director of the Clyde Valley Electrical Power Co., has died at the age of sixty-six. In 1950 Mr. Paterson made a claim against the South West Scotland Electricity Board, being awarded £52,408 by the Court of Session for loss of salary and pension rights resulting from the operation of the Electricity Act, 1947. Mr. Paterson was a partner in the firm of Wright, Johnston & Mackenzie, writers, Glasgow, and a director of Yarrow & Co., Ltd., and other companies.

Mr. Robert M. Gillies, who retired from the managership of the London office of G. & J. Weir, Ltd., in 1947, died on 27th May at the age of seventy-nine. Mr. Gillies served his apprenticeship with John Brown & Co., Ltd., and later was employed at Portsmouth and Devonport Dockyards. He joined G. & J. Weir as London manager in 1919.

Mr. F. E. Filer.—The death occurred on 26th May in his eighty-ninth year of Mr. F. E. Filer, of Ewell, Surrey. As a young man he was associated with the Siemens and Ferranti companies.

British Tenders in Australia

From Our Sydney Correspondent

Commonwealth officials are investigating claims by Australian manufacturers that a British "price ring" operates to undercut their prices. The Australian firms allege that British firms in the "ring" collaborate to keep prices up when it suits them, and also to drop prices when necessary. They believe that British firms are putting in some tenders to Australia at rates on which they cannot make a profit. The suggestion is that the "ring" selects one firm to put in an unprofitable quotation in order to break into a desirable market. The firm would be allowed to recoup its loss by being allotted the "cream" in some other field.

The Commonwealth is investigating the manufacturers' complaint because, if it could be substantiated, a case could be made out before the Tariff Board for the imposition of an anti-dumping duty to protect Australian manufacturers. The individual case put before the Commonwealth concerns a series of British tenders for the supply of heavy switchgear. The present rate of duty on British switchgear is 27½ per cent but Australian manufacturers are complaining that they are being forced out of the market even with this protection. They have told the Government that they believe British firms are quoting lower prices in Australia than in Great Britain for this equipment.

They have asked the Government to investigate because they say British authorities refuse to disclose the prices being paid for comparable equipment in Britain. They have cited a report by the Tariff Board in 1953 when it gave local manufacturers a protective tariff on electrical switchgear, which drew attention to wide differences between tenders for the same equipment submitted by British firms. It is said these differences might be explained by the varying efficiency of the British manufacturers if some of the tenderers were consistently high and some consistently low. But this was not the case, the Board said. A high tenderer for one contract was often the lowest for another.

The 1953 report came to no conclusion on the contention by Australian manufacturers that the British "ring" arranged which of its members should quote the lowest price for a particular contract, but it commented: "If it could be shown that lower prices are being charged for export to Australia than for home consumption, to the detriment of the Australian industry, there would be a case for consideration under the Customs Tariff (Industries Preservation) Act."

In the Senate in Canberra on 24th May the Minister for National Development, Senator W. H. Spooner, said he had no knowledge that British exporters of electrical equipment had formed a "ring" to exploit Australian markets. He stated that extensive tenders for electrical equipment had lately been advertised and 15 to 20 replies were received in response to one call for electrical supplies. Eight of the replies were from British electrical firms and they had each quoted the same price and terms. None of the British tenders had been accepted but instead a lower one from an outside source had been accepted, although the Government preferred to buy from British sources wherever it was possible. On the National News the same evening a report was read from New Zealand stating that an almost identical incident had occurred in connection with tenders for hydro-electric supplies for that country.

INDUSTRIAL NEWS

International Standardization

The third plenary session of the International Organization for Standardization is being held in Stockholm from 6th to 18th June. In addition to the I.O.S. Council and General Assembly fourteen technical committees are meeting. The list of British delegates includes the following:—Sir Roger Duncalfe, president of the British Standards Institution, Mr. H. A. R. Binnie, the director of that Institution, and several members of the staff, Mr. J. R. Cotterill (General Electric Co., Ltd.), Mr. E. H. Lee (Metropolitan-Vickers Electrical Co., Ltd.), Mr. H. Lister (English Electric Co., Ltd.), Mr. G. J. Pearmain (Philips Electrical Industries, Ltd.), Mr. F. H. Puxty (Greengate & Irwell Rubber Co., Ltd.), Mr. R. Ll. Rees (Central Electricity Authority) and Mr. C. T. Webster (Quasi-Arc Co., Ltd.).

Vehicle Bulb Price Reduction

The Electric Lamp Manufacturers' Association announces that the list prices of some of the more popular vehicle bulbs have become reduced in the order of 10 per cent as from 1st June. These reductions have been made possible by a greater degree of standardization of types and an increasing overall demand.

Revo Exhibition

A full-scale exhibition of its products has been opened by the Revo Electric Co., Ltd., at its works, Tipton, Staffs, which will remain open until 8th June. The purpose of the exhibition is to enable interested authorities to see at first hand a comprehensive range of the company's products. It covers street lighting fittings, floodlight equipment, domestic appliances, electric cookers, switch and fuse gear, and fans for desk, ceiling and wall mounting, and includes a number of items of new equipment. It has already been visited by electrical wholesalers, architects, surveyors, Area Electricity Board officials and members of Government Departments.

Plastics Materials Guide

A new guide has been published by the British Plastics Federation entitled "Buyers' Guide to Plastics Materials and Machinery and Equipment for the Plastics Industry." The guide, a 62-page booklet, has been considerably extended and includes particulars of materials in semi-processed forms such as sheet, tubing, etc. There is also a completely new section dealing with machinery and equipment for the plastics industry.

The names and addresses of the member companies supplying each type of material and machinery are given and the trade names used shown. All are indexed for ease of reference. At the head of each section of materials there is a note giving the principal properties and the more important applications of the material concerned. The cover, which is clear white with blue lettering, is laminated with a thin sheet of cellulose acetate—a plastics technique to keep the cover permanently clean and to withstand considerable hard-handling without wear. The guide is obtainable from the Federation, 47-48, Piccadilly, London, W.1, price 2s 6d

Batti-Wallahs' Society

The guest of honour at last week's luncheon of the Batti-Wallahs' Society was Air Marshal Sir Victor Goddard, K.C.B., C.B.E., who commenced his career in the Royal Navy, and his reminiscences as a midshipman in the early days of the 1914-18 war provided a highly entertaining address. Mr. G. O. Watson, the president of the Society, took the chair.

As many members of the Society will no doubt be attending the British Electrical Power Convention, it has decided to bring the June luncheon forward a week, and this will be held on Thursday, 23rd June. Members may wish to note in their diaries that next year's ladies' night will be held on 16th March.

Prices of Materials

In the accompanying table we give the basis prices of the more important materials used in the electrical industry. The figures given are the selling prices and are those quoted on Tuesday last.

ALUMINIUM Ingots	ton £163 0s 0d
COPPER, H.C. Electro	ton £333 0s 0d
Fire Refined 99·70%	ton £332 0s 0d
Fire Refined 99·50%	ton £331 0s 0d
COPPER Tubes ..	lb 3s 2½d
Sheet	ton £396 5s 0d
H.C. wire and strip ..	ton £370 0s 0d
LEAD, English ..	ton £102 15s 0d
Foreign	ton £101 0s 0d
MERCURY	flask £108 0s 0d
TIN, block (English) ..	ton £716 0s 0d
ZINC, G.O.B. Foreign	ton £91 5s 0d
Electrolytic	ton —
BRASS Tubes (solid drawn)	lb 2s 6½d
Sheet	ton £317 15s 0d
Wire	lb 3s 1¼d
PHOSPHOR BRONZE Wire	lb 4s 8¾d
PLATINUM	oz £29 0s 0d
RUBBER, No. 1 R.S.S. spot	lb 27⅛d—27⅞d

New E.A.W. Branch

The inaugural meeting of the Thanet Branch of the E.A.W. was held on 19th May, when the chair was taken by the Deputy Mayor of Margate, Lt.-Col. C. S. E. Witts.

The speakers were Miss Norah Balls, chairman of the E.A.W., Ald. Commander D. S. C. Thompson, R.N. (Retd.), chairman, South Eastern Electricity Consultative Council, and Mr. H. F. Knell, manager, Kent Sub-Area, South Eastern Electricity Board. The chairman of the Branch is Mrs. M. Carte.

Analysis of Absenteeism

In 1953 the British Institute of Management undertook an investigation into "Absence from Work, its Incidence, Cost and Control." The first step in the investigation was a pilot survey to test methods of recording and analysis. This stage has now been completed and the Institute has published "Absence from Work—Recording and Analysis," a standard system for compiling evidence on the subject. The method recommended shows information in a form suitable for inter-firm comparison as well as demonstrating the nature of the

A section of the exhibition arranged by the Revo Electric Co. at its Tipton works

problem within the individual concern itself.

The booklet contains an invitation to undertakings to participate in a nation-wide survey which will indicate the extent of the problem and provide suggestions for some methods of control. The preliminary investigation has been carried out with the support of leading companies and under the guidance of a committee representing the British Institute of Management, the Institute of Personnel Management and the Institute of Cost and Works Accountants. The booklet is available from the British Institute of Management, Management House, 8 Hill Street, London, W.1, price 2s 6d.

British Heaters for Canadian Stadium

The Empire Stadium shower rooms, built at Vancouver for the British Empire Games last year, are now heated by G.E.C. thermostatically controlled heavy duty unit heaters, which are approved by the Canadian Standards Association. These heaters are particularly suitable as they incorporate fans that circulate warm air and prevent condensation on the walls. They have been so mounted as to accentuate this feature, the warmed air flowing from the fans in a continuous circle.

Oil-Filled Radiators at the Paris Fair

Dimplex, Ltd., reports that at the Paris Fair considerable interest is being shown in its panel type radiators by French visitors to the exhibition. In the accompanying picture the British Ambassador in Paris, Sir Gladwin Jebb, is inspecting the company's display which showed the entire range of thermostatically controlled electric radiators, from ½ kW to 2 kW, and in eight colour finishes.

Sir Gladwin Jebb, British Ambassador to France, visits the stand of Dimplex, Ltd., at the Paris Fair

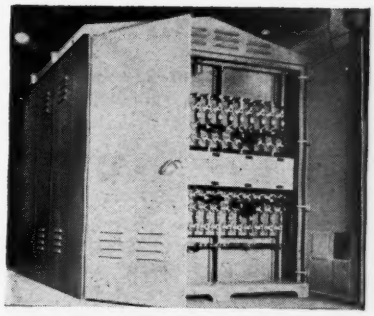
"Automatic" Cookery

From Forbes Publications, Ltd., 92a, Kensington High Street, London, W.8, we have received a copy of "Leave it to Cook," by Miss Joan Whitgift, of the Simplex Electric Co., Ltd. (3s 6d). This is a new cookery book designed particularly for use with time-controlled cookers and it opens with a chapter describing time control and its operation. The second chapter deals with the preparation of food for the oven; the next three chapters give a selection of recipes; Chapter 6 covers "special occasion" cooking; and the final one is entitled "Calculating Your Own Cooking Times."

Transformer Kiosks for Russia

Some information has recently been made available in connection with a substantial order placed by Machinoimport, Moscow, with Crompton Parkinson, Ltd., for ring main transformer kiosks. This order is valued at £700,000 and is one of several that were secured as a result of the visit to Moscow of Mr. J. B. Scott, sales director of Crompton Parkinson, Ltd., when he led a British Trade Delegation to Russia early last year. Dispatch of the kiosks, which commenced in April, is to continue on a monthly quota basis for completion at the end of 1957.

Each kiosk has three separate compartments which house, respectively, the h.v. switchgear, a power transformer and the l.v. switchgear. The h.v. equipment comprises a standard C.P. hand-operated, 300 A 10 kV off-load, air-break isolating switch for the incoming ring main feeder, and two air circuit - breakers, one for the tee-off to the transformer, and the other for the outgoing ring main feeder. The air circuit-breakers incorporated are of a design with a very low breaking capacity and for use with series h.r.c. fuses. The power transformer is a 320 kVA, 6,000 V/400 V, three-phase unit with star/star connections, made by the associate concern, the British Electric Transformer Co., Ltd.



One of the kiosks now being supplied by Crompton Parkinson, Ltd., for distribution networks in the U.S.S.R. Shown here is the l.v. end; the h.v. equipment is installed in the far end compartment and the transformer in the centre

In the l.v. compartment, ten specially designed 250 A 400 V, three-phase feeder units are fitted. Arrangements are made for coupling any two of these units to switch a single 500 A out-going feeder in one operation. Tubular heaters and adjustable ventilators are incorporated to enable the kiosks to be employed in outside temperature conditions ranging between plus and minus 40 deg C and to facilitate shipment the kiosks are designed to be dismantled into three cases, one containing the h.v. equipment and compartment complete, another containing the power transformer, and the third containing the l.v. equipment and compartment complete and the dismantled transformer compartment.

Electricity on the Farm

At the Royal Highland Show from 21st to 24th June the electricity display, which will occupy a space measuring 120ft by 60ft, is being organized jointly by the British Electrical Development Association, the South of Scotland Electricity Board and the North of Scotland Hydro-Electric Board.

In the dairy section, electrical equipment will be shown typical of that required for two types of dairy farmers, those with 20-cow herds, and those having 40 cows. This section will be divided into four parts: equipment for the 20-cow herd using direct to churn milking; for the 20-cow herd using bucket milking; for the 40-cow herd using direct to churn milking; and for the 40-cow herd using bucket milking. The pig rearing section of the stand will show examples of electric steamers and boilers for food preparation, and of electrically heated floors and lamp heaters for piglet rearing. Included in the poultry section will be several types of incubators, dull-emitter and bright-emitter lamps for chick rearing, brooders, egg washers and wet and dry poultry pluckers. A workshop section will show examples of electric

soldering irons, drills, sanders, grinders, polishers and welders.

A full size combined grain and wilted grass platform dryer with fans, heaters and switchgear, and E.D.A. scale models of an in-silo grain dryer and a platform grain dryer will be exhibited in the crop treatment section, and examples of power-driven meal mixers, grain mills, root cutters, grain elevators and conveyors and motor-driven pumps for water supply will be included in the barn machinery section.

Of particular interest to both the amateur and commercial grower will be the electro-horticultural section which will show a large greenhouse and a cold frame equipped with electric soil warming, tubular heating under the control of thermostats, light irradiation for tomato plants, etc., and soil sterilizers. A selection of electric hedge trimmers, lawn mowers, and other equipment, will also be on display.

Finally, women visitors to the "Highland" will be interested in a special display of domestic electrical apparatus.

Bulawayo Building Bureau

A Building Bureau, modelled on London's Building Centre, is shortly to be launched in Bulawayo, Southern Rhodesia. It will be housed in the thirteen-storey African Life Building now nearing completion in Main Street, in the heart of the city's shopping area. Bookings for exhibition space opened in Bulawayo on 1st June, and it is expected that the bureau will be opened to the public in October. The bureau will take the form of a permanent exhibition of all types of building materials, fittings and furnishings for domestic, commercial and industrial buildings.

The enterprise is a joint one by Ramsay, Parker Publications (Pvt.), Ltd., owners of the *Rhodesian Recorder*, and Mr. Laurie Wale, proprietor of the *Architect and Builder*, and the Cape Town and Durban Building Centres. The joint promoters are also the proprietors of the recently opened Building Centre in Salisbury. Information can be obtained from the *Rhodesian Recorder*, P.O. Box 1994, Bulawayo, Southern Rhodesia.

New Mullard Films

The manufacture of television picture tubes and of special quality valves are the subjects of two films made recently by Mullard, Ltd. "Made For Life" shows all the stages in the manufacture of a television tube, from the fabrication of the glass parts to fixing the type number label on the finished tube. Research, development and testing work are shown. This film is primarily intended for showing to radio and television dealers.

"Special Quality Valves" is a factual story of the development and manufacture of valves designed to withstand severe conditions of vibration and shock such as are encountered in military equipment and aircraft. It will eventually be seen by members of the electronics industry, large industrial firms, professional organizations, Government Departments, and the higher level educational institutions.

Atomic Energy Exhibition

Reference was made in our last week's issue to the international exhibition of the peaceful uses of atomic energy to be held in Geneva from 8th to 20th August. We are now informed that the closing date for applications for space has been deferred until 8th June. Applications should be sent to Mr. N. H. Campbell, Oxford House, 9-15, Oxford Street, London, W.1 (Gerrard 7033).

After-Sales Service

A new fleet of vans to provide after-sales service for housewives who buy food mixers and other electrical kitchen equipment has been established

A 10 cwt "J" type Morris van for Kenwood after-sales service

by Kenwood Electrics, Ltd. This fleet will be kept in permanent readiness to visit any housewife who requires help or advice in connection with her food mixer. Each service van is equipped with a work bench and necessary jigs. A demonstration model of a Kenwood mixer is mounted on the cab roof.

Washing Machine Works Expansion

Considerable developments have recently been made by Hoover (Washing Machines), Ltd., Merthyr Tydfil, Wales. In addition to extensions already carried out, it is planned, subject to final Board of Trade approval and with the co-operation of Wales and Monmouthshire Industrial Estates, to build an extension this year of 30,000 sq ft on the northern side of the existing factory building to provide further room for engineering development and production.

Dairy Trucks for Canada

Orders have been received by Smith's Delivery Vehicles, Ltd. (a member of the Rington Group), for seventeen "Commuter" dairy trucks. The two dairymen purchasing the trucks, Mr. D. Mason, of St. Catherine's, Ontario, and Mr. R. Slocombe, of Rockcliffe Dairy, Toronto, paid a special visit to Gateshead to place their orders. The trucks will be equipped with B.T.H. electrical equipment, "Exide Ironclad" batteries, and Westinghouse chargers. The stand-drive "Commuter" bodies will be insulated after arrival in Canada, and overnight cooling will be provided by means of a special cold-blow plant developed by Mr. Mason.

"Tele-chef" Service

The Hull Corporation Telephone Department introduced in March last the "Tele-chef" service in collaboration with the Yorkshire Electricity Board and the North Eastern Gas Board. On Tuesday, Thursday and Saturday menu hints and cookery recipes are supplied by the Yorkshire Electricity Board and they are recorded in advance by two lady demonstrators of the No. 6 (Hull) Sub-Area staff. The service on the other three weekdays is dealt with by the North Eastern Gas Board.

The Telephone Department has informed the Board that the number of subscribers' telephone calls received during the first six weeks of the service was 12,476.

Steel Flooring for U.S. Air Force

The material handling division of Fisher & Ludlow, Ltd., Birmingham, has received a contract from the U.S. Army Air Force in France for the supply of half a million lineal feet of "Flowstrut" electrically welded slotted angle and 120,000 sq ft of "Flowforge" open steel flooring.

Change of Name

James J. Hyde, Ltd., Belfast, agents for manufacturers of electrical equipment, have changed their name to William Reay (Belfast), Ltd.

Trade Announcements

A. B. Hobbs & Co., 214, Hatfield Road, St. Albans, Herts, have been appointed sole distributors in the United Kingdom for the Swiss-made "Zedes" electric soldering irons.

The Scottish service depot of **E. K. Cole, Ltd.**, has been transferred to 17, Cadogan Street, Glasgow, C.2 (telephone: Glasgow Central 3633/4).

CATALOGUES & LISTS

SURGICAL CAUTERY.—Illustrated leaflet introducing the "Oryx-Calvert" heavy duty electrically operated surgical cautery for hospital use.—**Anglo-Netherland Technical Exchange, Ltd.**, 3, Tower Hill, London, E.C.3.

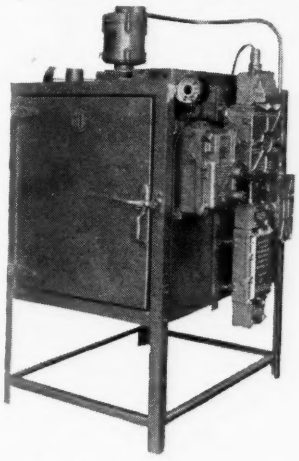
TRAFFIC BARRIER.—Illustrated leaflets describing the company's electrically actuated safety traffic barrier designed for the prevention of accidents in industrial premises and similar situations where vehicular and pedestrian traffic intersect.—**R. B. Pullin & Co., Ltd.**, Phœnix Works, Great West Road, Brentford, Middx.

WIRING ACCESSORIES.—Price list (W.915) for use in conjunction with the company's catalogue No. W.910.—**George H. Scholes & Co., Ltd.**, Wylex Works, Wythenshawe, Manchester.

NEW ELECTRICAL EQUIPMENT

Safe Heat Treatment Ovens

A.E.W., LTD., Imperial Works, High Street, Edgware, Middlesex, are now producing intrinsically safe ovens



A.E.W. intrinsically safe oven

suitable for Buxton Group 2 gases. Owing to their diversity, ovens are not certified flameproof but are built intrinsically safe, and shipped as completely assembled units ready for connection to the customers' main electricity supply and air ducting.

Robust double cased construction is employed with high thermal insulation between inner and outer cases, and the heavy sealed insulated doors are hung on heavy malleable iron hinges. Replaceable metal sheathed elements with special termination fittings outside the oven in flameproof boxes are rated so that their surface temperature is only slightly in excess of the working temperature of the oven. The temperature is controlled by a thermometer regulator in circuit with a specially adapted relay to reduce the contact load to a safe wattage and a safety thermostat is fitted in the same circuit to limit the temperature rise of the heating elements.

An impeller fan driven by a flameproof motor is fitted in the top of the oven chamber. The fan motor and heater control circuits are interlocked so that the heating elements cannot be switched on without the fan and in the event of the motor failing the heaters will be switched off. All electrical control gear and mains isolators are in flameproof housings.

Transistor-Grade Germanium

Transistor-grade germanium, single crystal and polycrystalline, is now available from G. A. STANLEY PALMER, Maxwell House, Arundel Street, London, W.C.2, to customers' specified resistivities, with life-times of excess minority carriers of 100 μsec, 200 μsec or more. Small sample orders are accepted from the smaller laboratories and research organizations.

Spotlight Fitting

A means of illuminating pictures and displays where the shape of the object only is lighted has been achieved by the use of the "Atomette" spotlight, manufactured by COURTNEY, POPE (ELECTRICAL), LTD., Amhurst Park Works, Tottenham, London, N.15.

The fitting consists of a side mounting projector spotlight unit with focusing adjustment utilizing a "Stelmar" optical system with a 24 V 48 W s.b.c. d.p. lamp. A 24 V output mains transformer is employed. The fitting has a throw of 10ft and illuminates an area of 9 sq ft with high intensity light. The area illuminated can be made to any desired shape and a suitable silhouette slide inserted in the optical system in order that sharp definition of the perimeter of the subject is obtained. To adjust the

"Atomette" spotlight fitting

throw and area to be illuminated, lens of varying focal lengths can be fitted. The price is £11 15s.

"Plateswitches"

The new range of 5 A "plateswitches" announced by the M.K. ELECTRIC, LTD., Wakefield Street, Edmonton, London, N.18, incorporates all the features of the earlier types (see *Electrical Review*, 16th July, 1954, p. 110) and is now designed for fitting with extra shallow plaster-depth boxes. In addition, a three-gang unit has been introduced. A point which greatly simplifies the range is the standardization of

M.K. Electric 5 A two-gang "plateswitch"

two-way switches in the two- and three-gang units, either of which can be wired as one-way if required. The prices per dozen are: 1-gang 1-way, brown 33s, ivory 37s; 1-gang 2-way, brown 43s 8d, ivory 47s 8d; 2-gang 2-way, brown 69s 4d, ivory 74s 8d; and 3-gang 2-way, brown 113s 4d; ivory 123s.

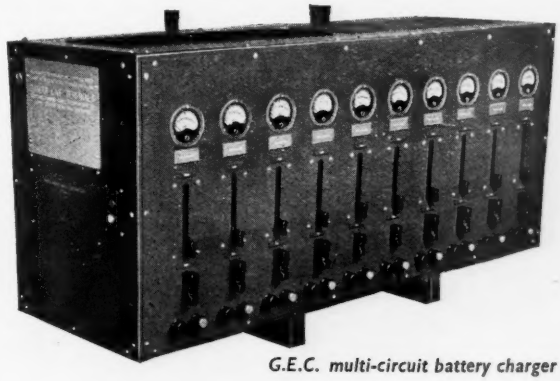
Printed Sleeves

We are informed by CREATORS, LTD., Plansel Works, Sheerwater, Woking, Surrey, that they can now supply printed sleeves in all colours and sizes. With their clear and concise priting, resistance to most oils and greases, and colour fastness under ultra violet light, these sleeves provide a permanent means of identifying cables. They are available in "Planvin" (p.v.c.), "Plantex" (rubber) and "Plansyn" (synthetic rubber), and in each case can be supplied printed to customers' specifications.

Multi-Circuit Battery Charger

A ten-circuit rectifier unit for charging lead-acid accumulators has recently been designed by the GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, W.C.2. Circuits 1, 2, 9 and 10 are for charging up to a maximum of six cells at 12 A; circuits 3, 4, 7 and 8 are for charging up to a maximum of twelve cells at 6 A; circuits 5 and 6 are for charging up to a maximum of twelve cells at 3 A.

The power supply is either 220/127 V or 440/254 V, three-phase 50/60 c/s. Each circuit has a full-wave bridge selenium rectifier, an ammeter for measuring output current and a resistor for adjusting the output. Fuses are provided to protect the d.c. and a.c. circuits and contactors with no-volt and overload protection are incorporated. Thermal protection is given by means of thermostats fitted above the rectifiers. The equipment measures 4ft 6in by 2ft 5in by 1ft 6in, weighs

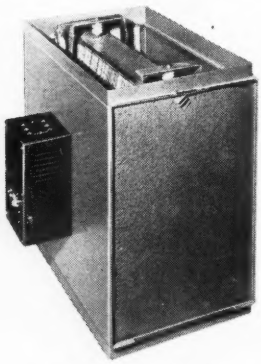


G.E.C. multi-circuit battery charger

320 lb and is dispatched complete and ready for installation. It may be used standing on the floor or bench, or wall-mounted.

Air Filter

AIR CONTROL INSTALLATIONS, LTD., of Ruislip, Middlesex, have produced the "Electro-Klean" air filter which is a dry type designed especially for small



"Electro-Klean" air filter

air conditioning units, and is based on the application of an electrostatic charge to a unit type filter cell containing a pleated mineral fibre medium. The filter is completely self-contained and can be attached to either end of a set of ducting. A power pack is incorporated giving an output of 500 microamps at between 11·5 and 12·5 kV. The output is derived from a radio frequency oscillator operating at a frequency of 80-100 kc/s. Filter cells have to be replaced periodically when the dust deposition becomes considerable.

Home Freezer

The Coldrator Division of the HOTPOINT ELECTRIC APPLIANCE CO., LTD., Peterborough, announces a new home freezer to be known as Model "VF.54." The freezer is of the vertical type and has been specially designed as a twin to the Coldrator "CS.71" de

Coldrator "VF.54" home freezer

luxe domestic refrigerator. It uses the same cabinet outer shell and door and is, externally, virtually identical.

The cabinet shell is of one-piece sheet steel construction, "Bonderized" for rust resistance, and finished in white or cream stoved enamel. Insulation is of resin-bonded fibre glass. The food storage compartment is of "hammered" pattern aluminium sheet lacquered in pale blue and the door has a balloon type gasket and incorporates a trigger action latch with lock.

The freezer has a capacity of 5·4 cu ft and a shelf area of 7·8 sq ft, and there are three refrigerated shelves finished with corrosion resistant white enamel. The cabinet temperature is thermostatically controlled and an audible alarm is fitted which indicates a rise in cabinet temperature beyond safe storage limit. A push button on the cabinet plinth enables the alarm to be cut off after it has been observed. The hermetically sealed unit is spring mounted and the system incorporates a wire condenser for extra efficient operation. The price is £96 19s 3d plus £36 12s 9d purchase tax in the United Kingdom. The service charge is £5.

Electro-Pneumatic Converter for pH Control

In collaboration with Foxboro-Yoxall, Ltd., ELECTRONIC INSTRUMENTS, LTD., 17, Paradise Road, Richmond,

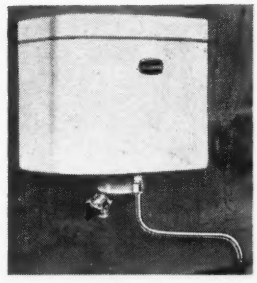
Electro-pneumatic converter

have designed and marketed an electro-pneumatic converter which, for the first time, permits pneumatic pH recording and control without the interposition of the electronic potentiometer. This results in a very considerable saving in cost and enables simpler and more robust pneumatic mechanisms to be used in the instruments which follow the pH meter.

This electro-pneumatic converter, model E28, is designed to be coupled to the E.I.L. model 28A industrial pH meter, and the output from this instrument, which normally ranges from 0 to 14 pH, produces a corresponding air pressure change of 3 to 15 lb/sq in. The converter consists of a small wall-mounting unit measuring approximately 8in by 6in by 5in. Its characteristics are zero to 1,400 mA for an output change of 3 to 15 lb/sq in with input resistance of 1,500 ohms. It will operate over its full range for an input of 0-1 V. The converter can, of course, be used for other applications where a small electric current is required to operate directly into a pneumatic servo-mechanism.

Water Heater

The latest addition to the "Creda" range of water heating equipment announced by the SIMPLEX ELECTRIC CO., LTD., Creda Works, Blythe Bridge, Staffs, is the 3 gal "Creda Crusader." Particular attention has been paid to the overall size, and the design is such that the water heater is virtually no larger than many models of half the capacity. Actual dimensions are 13¾in high by 14½in



"Creda Crusader" 3 gal water heater

wide by 10¼in deep, overall height being 2in extra. Loading is 2 kW and the model is available in two voltage ranges, 200/220 and 230/250, a.c. only.

Thermostatic control and efficient lagging cut down heat losses, and it is claimed that servicing can be undertaken in a matter of minutes. Except for an element change it is not necessary to break any water joints. The water container is of tinned copper and the outer casing is stove-enamelled. Finish is in cream or white with chromium fittings.

The price of the new model (Catalogue No. C.135) is £10 10s plus £4 1s 11d purchase tax in the United Kingdom.

Earthing Clamps

It is announced by M. MOLE & SON, LTD., Charlotte Street, Birmingham, 3, that their "Elmo" range of earthing clamps has been extended to fit all B.S. conduit sizes. Of robust construction, the "Elmo" clamp embodies non-ferrous materials of not less than 55,000 lb/sq in tensile strength and it is claimed that the earth wire cannot be pulled out of the clamp.

Four sizes are now available. Type A.123 is suitable for earthing cable sizes up to 7/·036, to fit B.S. conduit sizes 1, 2 and 3 (½ to ¾in), and for up to 7/·029, B.S. conduit sizes 1 to 5; Type B.45 for up to 7/·064, conduit sizes 4 and 5 (1 to 1¼in); Type C.67, up to 19/·064, conduit sizes 6 and 7 (1½ to 2in); and Type D.8910, up to 19/·083, conduit sizes 8, 9 and 10 (2¼ to 3½in).

Engineering in Europe

Abstracts from Foreign Technical Journals

THE most reliable type of thermal overload protection, particularly of motors, is based on the bimetal principle, in preference to the fuse or hot-wire principle. This is, above all, due to the fact that the flexure of the bimetal strips may be made a linear function of the temperature rise, and also to the possibility of fully compensating for the room temperature. A variety of bimetal elements may be used, viz., either flat or U-shaped strips, discs or even spirals. The bimetal elements may be heated either directly, or indirectly by heating resistances, parallel or series-connected with the bimetals. In a.c. operation the releases or relays may be supplied through current transformers, especially in the case of motors having comparatively long starting periods, when special types of transformers with saturable cores and thereby variable transformation ratio are used (" saturable " or " leakage " transformers).

The adjustment range of bimetal releases is from 0·7 to 1 × rated current and that of bimetal relays from 0·5 to 1 × rated current. The lower limit of this range is given by the lowest temperature at which the flexure of the bimetal element assures a reliable release and the upper limit by the permissible maximum temperature. Since the thermal processes taking place in the bimetal elements are fairly complex, the design and calibration of these releases and relays must be based on a simplified theory which has to be confirmed by systematic experiments. How this can be done is demonstrated by the author.—" Bimetal Releases and Bimetal Relays, their Characteristics and Calibration," H. Haas, *Siemens-Z.*, Vol. 29, No. 2, pp. 61-68, February, 1955, in German.

Transformer Noise Reduction

Transformer hum is produced in the core and the windings, partly even in the cooler of the transformer, and is transmitted from the core directly to the tank through the solid joint between the two, and also through the oil, the latter acting in this respect as an incompressible liquid transmitting the core oscillations to the tank which, in turn, passes them on to the air. The noise level near large transformers (100 MVA) may be as high as 95 db, which is unbearable. Noise reduction at the source, viz., by reducing the flux density, is expensive and not too effective. Since the production of the noise cannot be prevented, the only remedy available is to damp the waves propagating the noise by judicious interposition of damping materials in their way. It must be considered that the acoustic waves set up are reflected at the surfaces of separation between the different materials, viz., oil, steel and air, and even considerably amplified when entering a material with higher acoustic impedance. If, however, suitable damping materials are interposed at these separations, the reflected wave reduces the amplitude of the incident waves and this ultimately also lowers the noise level outside. An ideal solution would be the interposition of a continuous air cushion between oil and tank wall. Since this is not possible, air-filled metal cushions of corrugated thin sheets were found to be a good substitute, especially when combined with an elastic (rubber and springs) seating of the core on the tank bottom. In addition, a noise-absorbing construction of the transformer chambers is possible and should be carried out. It is possible to reduce the noise level from 90 db at the transformer to 30 db at the outside of the building.—" Methods of Damping Transformer Noises," V. Aigner, *VDE-Fachber.*, Vol. 18, Sect. II, pp. 38-43, 1954, in German.

Readers who require accurate full translations of any of the articles abstracted in this section can be put into touch with the translators who will supply them at current rates.—Editors, *Electrical Review*.

Ultrasonic Production Control

The advantages of the ultrasonic method of production control, particularly for thickness gauging, are its general applicability to a wide range of materials, viz., metals, glass, ceramics, some plastics, etc., and the fact that it can be used without access to both sides of the product (e.g., for pipes, boilers, partitions, sheets, etc.). In many cases it is the only non-destructive testing method available. Its mode of operation is that the frequency-modulated generator of the ultrasonic oscillations is brought into resonance with the natural frequencies of the tested object which are in a simple relation to its thickness; for accuracy of measurement, resonance must be obtained for at least one higher harmonic in addition to the fundamental. The sudden variations of the anode current of the generator valve on the establishment of resonance conditions are amplified and fed to the V-plates of an oscillograph. The standing waves set up in the tested object at resonance produce a pattern of characteristic peaks on the oscillographic screen. Certain types of welded work can also be tested for quality and continuity of the welds. The author analyses the theoretical conditions for optimum accuracy of the measurements.—" Ultrasonic Resonance Method of Production Control," Yu. V. Lange, *Elektrichestvo No. 1*, pp. 49-53, January, 1955, in Russian.

Telephone Interference

The interference effects of three-phase transmission lines on telephone cables are normally greatly mitigated by the screening effect of the earthed metal sheath of the telephone lines, but much less so where telephone lines are suspended on overhead line supports or led through common trenches with power cables. Also, in the case of single-phase traction lines with separate return through earth and, particularly, on two-phase faults of three-phase systems earthed through Petersen coils, single-phase faults in rigidly earthed three-phase systems, or unilaterally earthed single-phase traction systems, the inductive effects may become very marked and even dangerous.

The voltage set up between core and sheath of the telephone cable by neighbouring faulted h.v. lines depends on the length of the sections running parallel, approach of the lines, conductivity of the ground and magnitude and frequency of the fault current to earth. This voltage is reduced by parallel conductors and further by a suitable construction of the cable sheath. The latter reduction may be expressed by a " cable reduction factor r_c," which may be measured by a simple set-up on a short cable length (1 m). The phase relations of the voltages at various

frequencies may be determined by measurements with slightly modified Maxwell or Carey-Foster bridges. These characteristics may also be determined theoretically.

An optimum value of the cable reduction factor is obtained for small d.c. resistance and large inductance and iron losses of the cable sheath. Values of this order are achievable with lead-sheathed or corrugated-iron sheathed cables, as is proved by the results of numerous measurements on German standard types of cables presented by the author. The agreement between theoretical and experimental results is also quite satisfactory.—" Interference of H.V. Lines with Telephone Cables and the Cable Reduction Factors of Cables with Lead and Corrugated-Steel Sheaths," H. Lau, *Fernmeldetech.Z. (FTZ)*, Vol. 8, No. 3, pp. 153-161, March, 1955, in German.

Ice Loading of Lines

During the now proceeding revision of the VDE regulations 0210 the problem of the validity and suitability of the formula for determining ice loads stated therein is under discussion. The first paper investigates the formula by considering its experimental foundations and comparing it with the different formulæ adopted by other national regulations and with recent data obtained by an experimental station in Silesia during 1941-44. The author is in favour of replacing the parabolic law expressed in the formula by a linear law corresponding to that on which the formulæ adopted in other countries are based.

The new method of determining the ice load discussed in the second paper leads to the conclusion that the VDE formula has its merits more in the range of large and medium-sized conductors than of relatively thin wires, but that there is no reason to replace the formula as a basis of mechanical strength calculations of overhead lines. In exceptional cases, e.g., where " sticky " snow loads occur, the calculation must always be based on experimental work on site and cannot use " rules of thumb," i.e., overall formulæ.

The author of the third paper bases his considerations on evaluation of statistics of outages and damage caused by ice loads in the supply system of the big Bavarian Power Company and calls for a more accurate classification of the true causes of such events. In the light of these statistics the VDE formula would appear to offer sufficient safety to cover the bulk of possible events to be considered by the designer and could therefore be retained in the revised regulations.—" The Problem of the Ice Loading of Overhead Lines," comprising the articles: " Hoar Frost Deposits as Ice Load on O.H. Lines," W. Rier, " Methods for Determining Ice Loads," H. Mors, and " Outages and Damage to O.H. Lines by Ice Loads," H. Meyer, *E.T.Z.(A)*, Vol. 76, No. 8, pp. 277-288, 11th April, 1955, in German.

Polymer Type Dielectrics

It cannot be denied that investigations on dielectric characteristics and ageing phenomena of polymer-type dielectrics were hitherto mainly carried out on empirical or inductive rather than on theoretical or deductive principles. This is brought out by results such as the " ten-degree rule," etc., whereas the intimate study of the mechanism of the ageing processes, if it was undertaken at all, could not be regarded as more than rudimentary. Yet it is not too difficult, by classifying the partly simultaneous and partly successive processes from a physico-chemical viewpoint, viz., as polymerization and polycondensation, oxidation and thermal destruction processes, to establish some fundamental facts of the kinetics, reaction rates, catalytic influences and effects of extraneous factors on the basis of existing knowledge of the constituent macromolecules and to arrive at certain fundamental relationships. These, though long established in other fields of organic chemistry, can be proved to hold good for the mentioned constituent processes of the complex phenomena under consideration. Such relations are, among others, Ostwald's law of auto-catalytic reactions (particularly for elastomers and drying oils), or Van't Hoff-Arrhenius' equation linking temperature and reaction rate, etc.

Applied to a great variety of experimental results now available, some important agreements between these and the theoretical considerations indicated are found which enable some very general conclusions to be drawn, the most important of which are first, that the logarithm of any initial characteristic of the polymer considered varies linearly with the time of ageing; and secondly, that the logarithm of the useful life of a polymer-type dielectric is proportional to the reciprocal service temperature. These are the first relationships of the ageing of polymer-type dielectrics based on physico-chemical theory as well as on experimental facts.—" General Relationships of the Thermal Ageing of Polymer-Type Dielectrics," V. I. Kalitvyanskii, *Elektrichestvo*, No. 3, pp. 57-62, 1955. in Russian.

Stud Welding on to Small Curved Surfaces

A technique to enable $\frac{1}{4}$in diameter pins to be stud welded to the curved surfaces of $\frac{3}{8}$in diameter rods has recently been evolved by the Crompton Parkinson stud welding organization. By the simple method of jig construction employed for a recent order, an operator can accurately locate and weld two $\frac{1}{4}$in diameter mild steel pins 5·8in and 6·3in long respectively to a 1ft 11in long, $\frac{3}{8}$in diameter mild steel picket rod, and then bend each pin at right-angles at a pre-set position along its length, all in a " floor-to-floor " production time of only 25 seconds.

The complete operation is carried out in the following manner. The picket rod, to which the pins are to be stud welded, is placed on " V " blocks so that it abuts against an end stop. One of the pins, together with a special concave ferrule, is then loaded into the welding head which is mounted on a swivel above the " V " blocks so that it can be lowered to either of the two welding positions, the location of the welding head being by means of pillar slides which limit the swivelling movement; other pillars act as end stops to limit the downward movements. When loaded the welding head is lowered down the left-hand slide by use of a counterweighted lever, the first weld being effected by pressure on the push-button switch which is mounted conveniently on the lever. For the second weld, the operations are repeated with the welding head travelling down the right-hand slide.

The bending of the pins is then accomplished by rotating the picket rod through 90 degrees and clamping it in the " V " blocks so that the pins lie flat in a double-handed bending fixture. Operation of the bending device then effects the two right-angular bends simultaneously and the completed picket is removed by releasing the clamps.

As will have been gathered, the method of producing these flare pickets is extremely straightforward, the work having been reduced to a brief series of extremely simple operations which enable mass-produced articles of consistently high quality to be manufactured without any particular skill being required on the part of the operator. For these reasons alone, the combined use of bench mounted stud welding heads and simple jigs on lines similar to that described is finding increasing favour with production engineers concerned with many products that have hitherto involved either drilling and tapping or some form of arc welding in their construction.

Viscose Research Laboratory

Courtaulds New Establishment at Coventry

LAST month, Courtaulds, Ltd., began a series of open days during which they showed visitors and the Press their fine new laboratory in Foleshill Road, Coventry. Since the start of commercial production of viscose rayon at Coventry in 1905 practically all the company's research on this material has been carried out in laboratories near their Coventry factories but during the war it was realized that the future expansion of the "man-made" fibres industry was going to be very considerable and that research facilities would have to be greatly increased. The new laboratory represents one of the major projects in the planned expansion programme.

The new building is on land acquired in 1904 for the first viscose yarn factory; the buildings which stood upon this land were destroyed in air raids during 1940. There are four floors and a basement in the main block with an office wing linking it to the present offices, the arrangement inside the laboratory block being that of a central corridor with laboratories on both sides. Separating the corridor from the laboratories on each side is a gap of some 2ft and in this gap ducts run vertically through the building at very frequent intervals to carry all the services, including the electrical distribution. Access doors flush with the walls of the corridor provide adequately for any attention necessary, and for accessibility and ease of modification the system is one of the finest we have seen. On every floor from each vertical duct in the corridor wall of any laboratory a floor duct with removable covers runs across the whole width.

The basement houses the air-conditioning plant, the switchgear room and the equipment for producing the various compressed air supplies fed into each room. The general services to the laboratories and the building comprise high and low pressure steam and a condensate return; water for the laboratories, for flushing valves and for drinking; soft water, de-mineralized water and hot water; compressed air for general use, compressed air for instruments, and a vacuum service; town gas, and low temperature brine for cooling.

All services are distributed by header mains running through the basement at high level, with branches rising up the vertical distribution ducts on each side of the central corridor. From these vertical risers branch pipes are taken through the shallow ducts on each floor to island benches. The ducts continue to the outside wall, pass underneath the wall benches, and return alongside a similar duct in the next module. This arrangement makes it possible to provide piped services to benches in any position in any module and obviates the need for exceptionally wide trenches under the windows. Isolating valves are provided on incoming mains, at the bottom of each riser, and on the branch mains from each riser.

Steam is brought from the main factory through a 6in low-pressure (25 lb/sq in) main and 1½in high-pressure (175 lb/sq in) main. The h.p. steam main runs through the basement corridor and rises up to a small plant room on the first floor. Low-pressure steam is taken to the various air heaters for the air-conditioning plants, the heating and hot water service calorifiers and steam usage points. The condensate system returns condensate from the various steam traps on heaters, calorifiers and main trench points. The condensate is led to a main collecting tank in the basement plant room and pumped back to the factory boiler house.

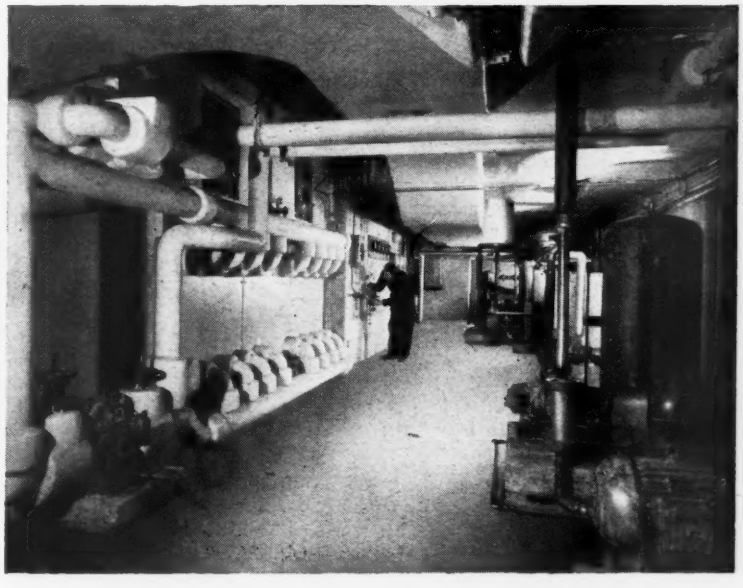
Compressed Air Supplies

Compressed air is supplied from a clean air compressor provided with a receiver. This unit has a capacity of 188 cu ft/min of free air when compressing to 30 lb/sq in, and is driven by a 40 h.p. motor. The compressor draws its air from outside and is cooled by a cold water supply from the town water main. Stand-by air supplies in case of compressor failure are from the main works supplies through a mat filter, followed by an alumina filter.

A special clean air supply is piped through a separate system for use in atmospheric temperature and humidity control instruments. The system consists of a rotary water-sealed compressor drawing its air from the outside and connected to a large air receiver to ensure constant pressure. The air passes through an automatic "Humidryer" air dryer which has two drying cells, one being regenerated while the other is in use. Automatic change-over gear is provided so that the air supply is always being dried without attention. In order to provide a stand-by for this compressor, the air receiver is cross-connected to the air receiver of the general supply. The compressor has a capacity of 30 cu ft/min of free air when compressing to 40 lb/sq in.

The circulating brine service is obtained from the factory refrigeration plant for use in the air-conditioning systems.

Service plant in the basement of Courtaulds new laboratory



The service is also extended to certain points in the laboratory. The temperature of the brine supply is approximately 20 deg F.

Heating and Ventilation

For general heating and ventilation warmed and filtered air is distributed from a central plant through a plenum system which is divided into three zones per floor. Each zone is under separate heating control by means of pneumatically operated indicating controllers, to allow for the different fabric heat losses from each section. Air distribution ducts have been formed by encasing the floor beams to form the branch ducts at ceiling level, the air discharge grilles being of the type to give horizontal/vertical control over air direction. The main delivery ducts are run in the false ceiling space over the corridors and the zone heaters are fitted to the branches coming off the main rising air shaft.

A spray type humidifier is incorporated to give up to 50 per cent relative humidity during the lowest outside winter conditions, and a pre-filter of the oil coated type is fitted. A main air heater inserted after the humidifier can raise the full air volume to 60/65 deg F. The humidifier will also give some degree of cooling in hot weather. No re-circulation of air is provided for in the chemical laboratories.

Part of the laboratory requires constant air conditions of 68 deg F and 65 per cent relative humidity. This area is served by a separate spray type air conditioner, water for which can be steam heated or brine cooled. Zone air heaters are fitted on the distribution ductwork to give exact conditions in the areas treated.

The electrical system takes a 415 V three-phase supply from the factory power station, brought in to a main fuse-switch type distribution board, housed in a separate room in the basement. From there supplies are taken to fuseboards which feed ten sets of vertical rising mains. These mains consist of 100 A v.r.i. cables carried on hardwood clamps in rectangular steel trunking, and run from the ground to the top floor in the ducts provided for this and other services.

Tappings are taken from the rising mains to separate lighting and power distribution fuseboards, fitted with h.r.c. cartridge fuses. These are situated near the rising mains and provision has been made for any main to be tapped at any floor level, as required. From these fuseboards lead-covered v.r.i. cables are taken in floor ducts with removable covers to laboratory benches to feed socket outlets. There are about 1,000 sockets mounted on vertical service strips along the back or centre of the benches. Because the loading factor is low and up to ten sockets can be connected to 240 V spur circuits, 13 A fused plugs with switched sockets are used. Where 415 V, three-phase supplies are required for experimental work switch-fuses or overhead busbars are provided.

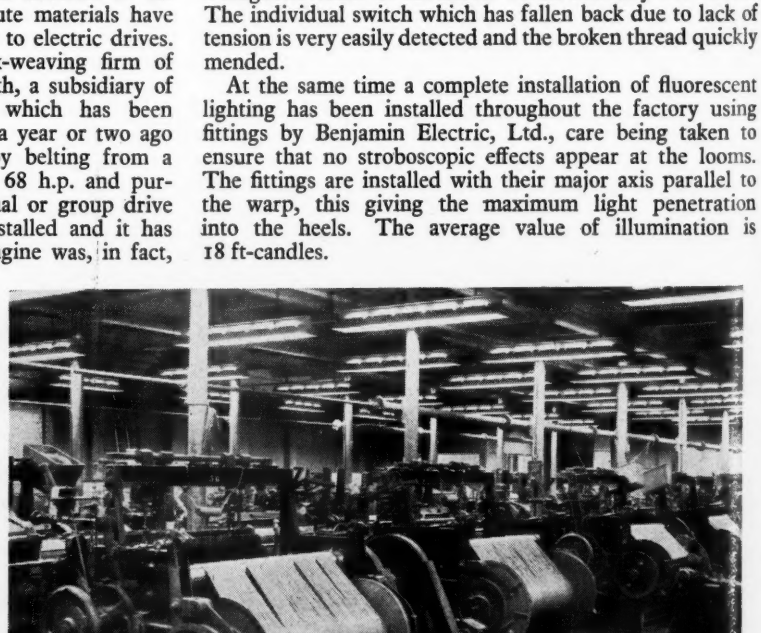
Fluorescent lighting is used to give a general intensity of about 30 lumens/sq ft at the working surface. Fittings are mounted direct on the ceiling and have "Perspex" reflectors, moulded p.v.c. louvres, and instant-start control gear.

Electrification in the Flax Industry

MANY of the small and medium-sized factories in the East of Scotland producing flax and jute materials have recently been changing their mills over to electric drives. Typical of many of these is the flax-weaving firm of Anderson & Chalmers, Ltd., at Arbroath, a subsidiary of British Ropes, Ltd. This company which has been established for about 150 years, up to a year or two ago drove its warping creels and looms by belting from a horizontal steam engine supposedly of 68 h.p. and purchased second-hand in 1886. Individual or group drive from electric motors has now been installed and it has become apparent that the old steam engine was, in fact, developing about 200 h.p.

Totally enclosed motors have been used throughout because of the large amount of dust coming from the coarse flax yarn. Capacitors are installed for power factor correction and maintain this at about 0·95. Modern automatic individually driven looms have been installed and to catch up with the increased production from these a new high-speed warping creel of the latest pattern has also been installed. This employs multiple switches held open by the tension on all the threads. Should one break, the tension switch associated with it closes and actuates a magnetic brake on the motor via an auxiliary l.v. circuit. The individual switch which has fallen back due to lack of tension is very easily detected and the broken thread quickly mended.

At the same time a complete installation of fluorescent lighting has been installed throughout the factory using fittings by Benjamin Electric, Ltd., care being taken to ensure that no stroboscopic effects appear at the looms. The fittings are installed with their major axis parallel to the warp, this giving the maximum light penetration into the heels. The average value of illumination is 18 ft-candles.



New automatic looms at Arbroath

Earth Leakage Protection

The Sub-Division of Voltage-Operated Trips in Domestic Installations

By T. C. GILBERT, M.I.E.E.

EVER since the introduction of the voltage-operated earth leakage circuit-breaker the general practice has been to use the device as a main switch controlling the installation, as a result of which the occurrence of an earth fault shuts everything down, puts the consumer in darkness and stops all his clocks or clock-controlled equipment. Previously, in his reliance upon the sub-circuit fuses, the consumer had become accustomed to losing only part of his installation in the event of fault; at least some lighting remained and to a certain extent he was given an indication as to where the fault might lie. Although the addition of a voltage-operated trip to his installation made protection more reliable and effective, yet the consumer might be forgiven if, in his ignorance, he considered it a retrograde step after the first fault and shut-down.

Another, and possibly more serious, effect of this practice has been to limit, or even prevent, the occasional check of the earth connection and the breaker mechanism by means of the test key, as, for one thing, the device would generally be situated in some more or less inaccessible cupboard cluttered up with brooms and other household gear. For another, it is rarely desirable that everything should be shut down, especially if the installation includes the alarm clock upon which the consumer relies for his prompt attendance at his place of business. The mere fact that the device is out of sight increases the risk of no check, and no protective system employing small light mechanisms, possibly fixed in dusty or damp situations, can be considered reliable without an occasional check; one of the chief advantages of the voltage-operated trip is this simple facility for check.

Metalclad Installations

Sub-division of voltage-operated protection introduces its problems. It is not possible to secure selectivity between sub-circuit and main trips by arranging for them to be responsive to different voltages, that is to say, a 40 V leakage potential for the main trip with sub-circuit trips set to operate at 30 V, in the hope that the lower-set devices will operate on a sub-circuit fault before the main trip can do so. Where metalclad wiring systems are used a fault potential on any section will be extended throughout the whole, on to the main conduits equally with the sub-circuit conduits, and as at the moment of impact of an earth fault this potential may approach the full mains voltage it is obvious that all trips anywhere in an installation of this type will operate simultaneously.

The E.R.A. Report Ref. F/T122 described and illustrated two methods whereby metalclad installations might be split up into sections, insulated from each other by gaps or insulating bushes, intended to secure some measure of selectivity of leakage protection by confining operation of sub-circuit voltage-operated trips to the affected section. This might be effective if the conduits or metal sheathing could be kept clear of all extraneous metalwork, but this is hardly possible in practice. In blocks of flats where it may be desired that leakage protection shall be arranged to each flat separately, although it may be possible to segregate the conduits of each individual flat, it cannot be ensured that there will not be some fortuitous contact between conduits and structural steelwork, and this would completely stultify any kind of selective operation between the various trips.

The occurrence of an earth fault in one flat would extend a leakage potential via the steelwork to conduits of another flat, and probably all trips in the building would come out simultaneously. Further, with the later installation of electric water heaters in the flats immediate electrical connection is made between the conduits and the water supply piping of the whole building, and any pretence to selectivity is defeated, with serious inconvenience to all concerned. Selective operation of voltage-operated trips in blocks of flats can only reliably be secured with the use of non-metallic wiring systems, non-metallic conduits, t.r.s. or plastic sheathed cables, but even this does not completely solve all the problems.

Even this degree of selectivity is inadequate (one trip per flat is no better than one trip per house) as it still leaves the individual occupier to suffer the inconvenience of a complete black-out in the event of a minor earth fault, such as the boiling over of liquids on to exposed elements, and he should not be expected to accept this as the best that can be done. Earth faults on the enclosed wiring of an installation are few and far between; most of these occur on appliances or equipment or their connecting flexible cords. It might therefore be accepted that voltage-operated protection is, to a certain extent, wasted when employed for the protection of enclosed wiring in a well-carried-out job, and it would be much better to confine it to the protection of connected equipment, both on the score of lowered cost and of greater convenience and efficiency. This desirable objective has been brought considerably nearer with the appearance of lower-rated trips, usually 15 A, with or without a 13 A socket-outlet incorporated.

Local Trips

Such appliances as washboilers and washing machines should always be connected through a local trip of this character, as they are invariably used where warm and wet conditions prevail and effective earth leakage protection is essential. Local installation of the protective device has another advantage; the user can be prevailed upon to use the test key as the normal method of switching off, thus ensuring a continuous check of mechanism and earth connection; in the writer's view this check is essential if reliability is to be ensured, especially in this kind of situation, and as it is so simple there should be no hesitation on the user's part to adopt it. There will not be if she is told that the pressing of the red key instead of the black is a step designed for her own safety, and that the normal " off " key need only be used if the trip sticks in, in which case she must report the fact at once. It is thought that this is the only " education of the public " necessary; it could be reinforced with a small notice posted over the trip. As regards the cooker, control units incorporating a voltage-operated trip are already available and fairly popular, and these cover both the cooker and auxiliary circuits.

The position is intensified with the recent appearance

and growing popularity of washing machines with gas heaters and electric drive for agitators or wringers, and we are told that a dish-washing machine is likely to follow. How far the electrician will be called in for the installation of these appliances is a moot point, but it will be generally agreed that this combination of gas and electric services will need adequate leakage protection even more than all-electric appliances. Not only is the matter of shock involved, but there is always the possibility of a heavy earth fault current firing gas should this flow to earth via any metallic solid gas connection. Dealing with an investigation into the resistances of asbestos-cement water mains at Manchester and Rochdale, the E.R.A. Report Ref. F/T101 showed by two tables that in the majority of cases the resistances of gas services into various houses were considerably lower than those of the water services (two comparisons are 0·78 ohm for the gas service against 6·3 ohms for the water service, and 0·6 ohm for gas as against 2·95 ohms for water) and this can only mean that even if the appliance appears to be soundly earthed to the water service yet there is a serious risk that the greater part of any earth fault current would flow via the gas pipe.

Possibly the gas authorities do not fully realize the risks involved—one advertisement for the gas-cum-electric washer described it under the name "Live Water," which might be prophetic—but the electrical engineer suffers under no illusions on this score. In the best interests of both gas and electrical services installation engineers should approach their local gas friends and suggest the installation of a local leakage trip in order to afford protection against the dual risk of fire and shock; it is being done in at least one area. As far as can be ascertained, these gas-heated electric washers are proving popular in some districts, as owing to the existence of a gas service to the cooker and the high cost of installing wiring for an all-electric washer of similar type, their use appears economical in first cost; as similar conditions exist all over the country their use is likely to expand.

Assuming that the installation of a 15 A trip with a 13 A socket-outlet has been approved for use with a washer of this or any other type, the earth connection from the trip could be made to any convenient near-by point—even, with a non-metallic gas connection, to the gas pipe! After all, the trip is concerned only in the event of a voltage arising between the machine and the gas point, and there is little chance of any heavy fault current flowing down the gas pipe, as the high-impedance trip coil will prevent this; in any case, the designed passage of 70-80 mA is preferable to the always possible passage of 30-40 A. However, probably other earth connections will be readily available in the average kitchen or wash-house, or even the conduits of the installation under some circumstances and if reasonably continuous.

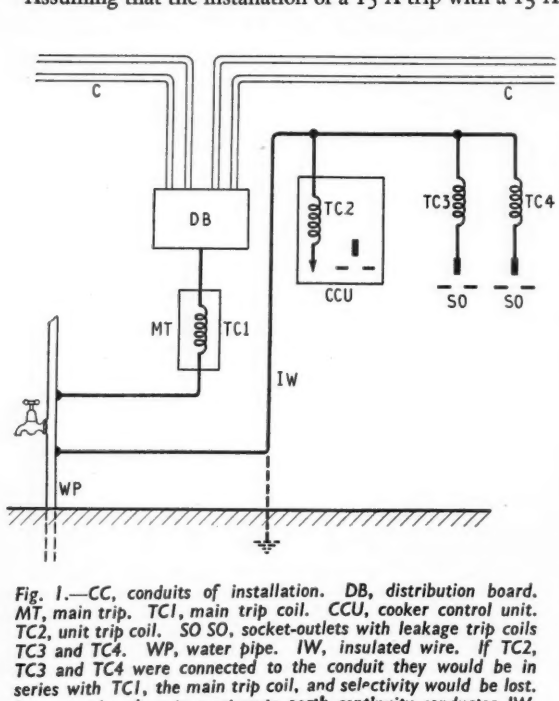


Fig. 1.—CC, conduits of installation. DB, distribution board. MT, main trip. TC1, main trip coil. CCU, cooker control unit. TC2, unit trip coil. SO SO, socket-outlets with leakage trip coils TC3 and TC4. WP, water pipe. IW, insulated wire. If TC2, TC3 and TC4 were connected to the conduit they would be in series with TC1, the main trip coil, and selectivity would be lost. By connecting them to a separate earth continuity conductor, IW, they remain independent of TC1

Should a main intake position leakage trip be already in existence, the conduits of the installation should not be used for the earth connection of local trips, as this may have the effect of placing the trip coils of local devices in series with the main trip coil, with unwanted operation of the latter. Where local trips are used, therefore, and the consumer has already equipped himself with a main trip, a separate earth connection must be used for local trips, whether cooker control units or socket-outlets, if selectivity of operation is to be ensured, and this is further aided with the use of a small lightly-insulated wire for the purpose; this additional earth continuity conductor may be run to the water main, cable sheath or even an independent driven electrode. The arrangement is shown in Fig. 1, and it will be noted that one auxiliary earth connection may pick up any number of local trips.

The writer is of the opinion that the *local* application of voltage-operated trips is the logical answer to problems of effective leakage protection. It is selective, which the main trip is not; it is installed as and when required, involving no installation problems such as segregation of conduit runs; it can be applied to any and every type of installation and circuit without modification, and, probably as important as anything, the efficiency of the protection afforded is subjected to constant check under normal working conditions, which cannot apply to *any* alternative method. It is thought that for the small extra cost involved the manufacturers of washboilers and washing machines, all-electric or gas-electric, and similar equipment should include a combined 15 A trip and 13 A socket-outlet as part of their standard equipment, and as a small insurance premium against the possibility of their appliances becoming involved in regrettable happenings.

The Only Effective Protection

The writer makes no apology for advancing the view that the voltage-operated trip is the only form of protection likely to be effective with these types of appliances. It is thought that the time has come to discount even the possibility of direct earthing being good enough as an alternative, and to end our complacency in this connection. Not only has the recent eye-opener of the E.R.A. Reports concerning conduit impedance blown up, with the realization that this factor is inescapable even with the highest grade of workmanship, and that our earth continuity conductors are nothing like as good as we had thought them to be, but the writer detects a tendency to place far too much reliance upon loop testing as indicating a satisfactory state of affairs for the application of direct earthing.

Reverting to the conditions previously mentioned in connection with the Manchester and Rochdale tests, if, before the reported investigation, normal loop tests had been made in the generally accepted manner, what would have been the result? With water supply pipes exhibiting resistances of 1·7, 2·95, and 6·3 ohms with, in the same

houses, gas services with resistances of 0·27, 0·6, and 0·78 ohm respectively, in any house in which gas water heaters were used, involving the metallic connection of gas and water services, a loop test would have indicated the lower values as being applicable to the earth fault path. This would, in effect, have resulted in the installations being earthed through their gas services, with all that this involves, and one can never be sure that designed earth continuity conductors are not shunted by other lower-impedance circuits, such as those mentioned or by plenty of others available in the average building; loop tests will not indicate this condition, which must leave disquiet in our minds when we consider the increasing proportion of fires of electrical causation. Yet what other form of test can be devised that will afford an unfailingly reliable picture of earthing conditions, short of the insulation of the earth continuity conductor and its recognition as an installation conductor in its own right, and not something to be afforded automatically with some kinds of wiring systems. We are informed that new and drastic testing methods will be required in the forthcoming edition of the Wiring Regulations, and their appearance must be awaited, but it is difficult to visualize any form of test that will overcome the complication of the shunted earth conductor.

News from India

By Our Bombay Correspondent

LAST year the general index of industrial production in India, which stood at 135·3 in 1953, rose to 145 while the general index of prices dropped from 399·6 to 367·8. The increase in production was very widespread. Finished steel production reached the record total of 1,226,000 tons, 200,000 tons more than in the previous year.

The electrical industries had a good year in contrast to the fall in production in 1953. There was a decrease in production only in two items, namely bare copper conductors and domestic refrigerators. The electric motor industry made considerable progress and motors of the slip-ring type up to 125 h.p. are now being manufactured in the country for the first time. Similarly, transformers up to 3,000 kVA and 33 kV are also being produced. Of the new products manufactured during the year, mention may be made of brass caps for electric lamps, and miners' cap lamps. The capacity for the production of electric motors, transformers, switch and control gear, cables, wires and electric fans is expected to expand during this year. The accompanying table gives industrial capacity and production of some of the electrical industries during 1954.

Industry		Installed Capacity 1953	Installed Capacity 1954	Actual Production 1953	Actual Production 1954
Cables and wires:					
Alumin. conductors	tons	6,620	9,020	3,280	5,481
Bare copper do.	tons	20,000	27,800	7,372	7,576
Rubber ins. cables and flexibles	mill. yds	45	86·84	48·43	62·72
Electric motors	h.p.	200,000	200,000	162,525	186,644
Electric steel sheets	tons	4,500	4,500	2,936	4,513
Power transformers	kVA	328,000	328,000	308,084	398,224
Radio receivers	thous.	153·1	153·1	56·270	58·61
Storage batteries	thous.	350·1	290·1	175·999	188·4
Electric lamps	million	29	29	19·67	22·86

Imports and exports were higher than in 1953 both in volume and value. The higher level of industrial activity was reflected in the nature of imports, which consisted largely of industrial raw materials such as metals, mineral oils, dyes, chemicals and cotton. The increase in exports was even more pronounced at Rs.563 crores,* Rs.31 crores more than in 1953. The United Kingdom and U.S.A. continued to be India's principal buyers and suppliers. There did not seem to be any radical redirection of trade despite the greater political importance attached to Asian countries. In fact, Burma and Japan imported less from India, while West Germany and Australia imported more.

Four alternative schemes varying in cost from about £22·5 million to £64 million for the exploitation of lignite deposits at Neyveli, Madras, have been recommended to the Government of India by Powell Duffryn Technical Services, Ltd. A technical committee has now been appointed to draw up a project report in collaboration with the consultants. The lignite deposits in the south are spread over an area of about 100 square miles and are estimated to constitute a reserve of over 200 million tons. There is no other fuel in the south, an area also not well endowed with water power potentialities. The cost of coal imported from the Bihar collieries works out at about Rs.37 to Rs.50 per ton in Madras and other parts of South India while it is only about Rs.12 to Rs.18 in the north. It is estimated that the pithead price of lignite will be about Rs.15. The lignite has 56 per cent moisture content.

The scheme which it is considered is most likely to be chosen provides for the processing of 3,273,000 tons of lignite to produce 211,000 kW of power, 200,000 tons of ammonium sulphate and 714,000 tons of briquettes a year. It will probably be put in hand by the beginning of next year.

* Re.1 = 1s 6d; Rs.1 crore = £750,000.

Industrial Safety Conference

NEARLY 700 delegates attended the National Industrial Safety Conference, organized by the Royal Society for the Prevention of Accidents, at Scarborough (20th-22nd May).

Among the points made by Sir George Barnett (H.M. Chief Inspector of Factories) in his presidential address was that in the United Kingdom there were about 250,000 establishments registered as either factories or workshops and, of these, 22,000 were sufficiently sizable to employ not fewer than 50 people. Yet, even so, only about 4,000 of them were known to have an appreciable safety organization or to have thought it worth while to become members of the Royal Society for the Prevention of Accidents. There were, therefore, 18,000 factories, all employing not fewer than 50 people, which were ripe for gathering into the safety movement.

The following papers were presented at subsequent sessions:—"Management and Safety," by H. L. Ginaven; "Safety in the Ironfoundry," by Colin Gresty; "Safety Incentives," by John Gardner, M.A.; "Planned Maintenance of Equipment at Building Sites," by W. T. Scopes; and "The Part of the Insurer in Industrial Accident Prevention," by E. S. M. Connor. There was also a debate on the motion: "That this Conference agrees that a safety committee forms an essential part of an accident prevention organization."

Electrical Contractors and the Building Regulations

Two Recent Court Decisions

By C. F. MAYSON, A.M.I.E.E.

CONTRACTORS are possibly not generally aware that the carrying out of electrical installation work in new buildings may bring them within the provisions of the Building Regulations. Recent decisions in the Courts (one in the Court of Appeal) have, however, demonstrated that this should not be regarded as a rare occurrence with which the majority of electrical contractors have no need to concern themselves. It is, therefore, advisable to investigate the position in the interests of all.

The Building (Safety, Health and Welfare) Regulations, 1948, made by the Minister of Labour and National Service by virtue of powers conferred on him by the Factories Act, 1937, are applicable (Reg. 2) to " the construction, structural alteration, repair or maintenance of a building (including re-pointing, re-decoration and external cleaning of the structure), the demolition of a building, and the preparation for, and laying the foundation of, an intended building . . . , and to machinery or plant used in such operations. . . ." Exceptionally, " pole or lattice work structures designed solely for the support of machinery, plant or electric lines " are not " deemed to be buildings."

Accident at Bankside

In *Elms* v. *Foster Wheeler, Ltd.*,* the plaintiff, a steel erector, claimed damages for personal injuries sustained whilst he was working for the defendants, who were then engaged in the installation of steam generating plant at the Bankside power station. It was alleged that there was a breach of Reg. 30 (3) of the Building Regulations, in that the plaintiff fell thirteen feet from some open steel joisting which should have been boarded or otherwise covered. The principal point which the Court of Appeal had to decide was whether the Building Regulations applied; it was held that they did apply.

The question at issue was, to quote Lord Justice Romer, " whether at the time of the accident a building was being constructed and whether the defendants were contributing to its construction." The learned Lord Justice explained his use of the word " contributing " by saying that it was quite plain that " the construction of a building " in Reg. 2 meant " the construction of a building *or any part thereof*." " Building " is not defined, but it is used in a very wide sense, so that the specific exclusion of " pole or lattice work structures " suggests that structures of a more solid kind designed for the same purpose are included. The steel joisting from which the erector fell was part of a very large structure which could be regarded only as a component part of the whole building, inasmuch as it was designed to support plant which it was the primary object of the building to house. The defendants were, therefore, " contributing to its construction," and the Building Regulations must apply.

That decision was followed and applied by Mr. Justice Ashworth in *Hughes* v. *McGoff & Vickers, Ltd.*† This was a claim brought by the next-of-kin of an electrician who had received fatal injuries when struck by a length of conduit which had fallen from scaffolding some thirty feet above him. The defendants were electrical contractors engaged under sub-contract in the installation of electrical equipment in a large workshop which was still under construction. Part of the work involved the fixing of conduit to roof members, and for this scaffolding was used. It was alleged that the length of conduit which had killed the electrician would not have fallen had the scaffolding been fitted with toe-boards as required by Reg. 24 of the Building Regulations.

The learned judge considered that the installation of conduit in these circumstances definitely formed part of the construction of the building, to which the defendants were, therefore, contributing, and the Building Regulations applied. In coming to that decision Mr. Justice Ashworth stressed what the Court of Appeal had emphasized in the *Elms* case, namely, that there is no question of the Building Regulations applying to every installation of electrical apparatus in buildings under construction. It is a matter of whether, in a particular case, the operation can be said to " contribute " to the construction; that is a question of fact, depending upon the circumstances.

It may be noted that these Regulations apply, not only to the " construction " of a building, but also to " structural alteration, repair or maintenance," as well as to " machinery or plant used in such operations." It may well be that work done on electrical equipment could be said to " contribute " to alterations, repairs or maintenance of buildings, for the decision in the *Elms* case would still apply. As to " machinery or plant," it should be remembered that the relevant Regulations are Nos. 85 and 86, and that Reg. 100 applies the provisions of Section 17 of the Factories Act, 1937 (which concerns those who supply the plant, whether by sale or on hire), to machines not complying with Reg. 86.

One last point to note. The Factories Act, 1937, by Section 107, applies to " building operations " which, by definition, are the same operations as those to which the Building Regulations apply. This means that the Electricity (Factories Act) Special Regulations, 1908 and 1944, must be observed in so far as they are applicable and are not excluded by Exemption 8 of those Regulations.

* (1954) 1 *Weekly Law Reports* 1071.
† (1955) 1 *Weekly Law Reports* 416.

Institute of Metals Essay Prizes

THE Council of the Institute of Metals is to present two prizes for the best essays submitted. The competition is open to student members of the Institute, to associate members of local sections and to all members of associated societies who are eligible for student membership of the Institute, provided that they are within the normal age limits for student membership, viz., 17 to 25 years. The choice of subject is left to the competitors, except that subjects relating exclusively to extraction or ferrous metallurgy are ineligible. It is intended, though this may be varied as may be found necessary, that one prize shall be awarded for a paper on a theoretical subject and the other for a paper on a practical subject. The prizewinners will receive their prizes from the president, when he presents the medals awarded by the Institute, at the 1956 spring meeting.

Porcelain Insulator Testing

New Equipment at a Tamworth Factory

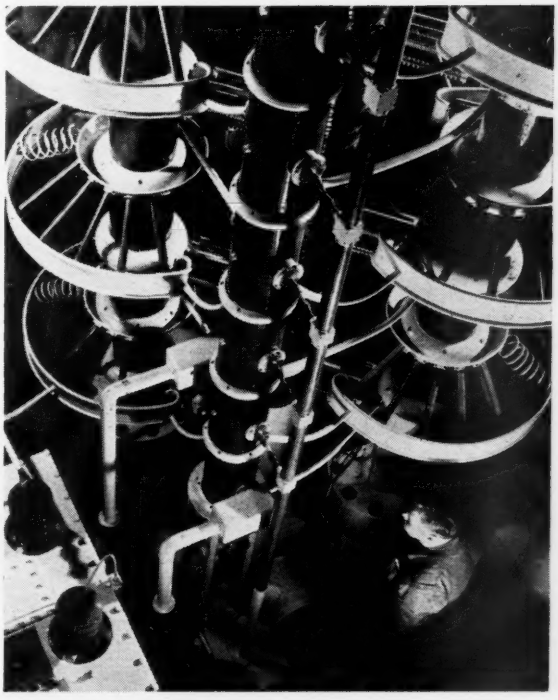
IT is accepted practice that insulators shall undergo high voltage tests to determine the characteristics of a particular design, and shall be given routine electrical tests to prove the quality of their manufacture. The normal test to show freedom from manufacturing defects is one in which the insulators are vigorously flashed over, and it requires a voltage which often exceeds ten times the working level of the insulator. It eliminates those which may puncture below the flashover voltage, but even this test fails to reject every insulator which is below the required standard.

An alternative method which, in the opinion of many engineers, is more searching is to flash over the insulator by applying a sustained high voltage test in which the voltage takes the form of a succession of transient damped oscillations with high frequencies (for example, 100 to 200 kc/s). The generators normally used for this duty are Tesla coils.

Unfortunately, this combination of high voltage and high frequency severely limits the total capacitance, and therefore the number of the porcelain insulators which can be tested at one time by a Tesla coil. Thus, at the suggestion of Messrs. Merz & McLellan, consulting engineers, a new form of generator to facilitate effective factory production has been developed by the British Thomson-Houston Research Laboratory at Rugby and is now installed at the Tamworth factory of Doulton & Co., Ltd.

This generator is capable of applying high transient oscillatory voltages to a number of porcelain insulators at one time under conditions which involve feeding the insulators with some 80,000 kVA of oscillatory energy. There is resemblance to a Marx impulse generator in that eight condensers are charged in parallel and discharged in series.

The equipment differs, however, from conventional impulse generators in being charged and discharged recurrently 50 times a second, and in achieving its discharge through inductance so that the resulting voltage transients are oscillatory; it is these transients which involve the high kVA of oscillatory energy. At full rating the mean power input to the generator is some 22 kW, and of this power about half is available for dissipation at the porcelain insulators in the form of corona and other dielectric losses. The transient generator is 17ft high and is built in five columns, two formed of condensers, two of inductances, and the fifth of spark gaps.



The transient generator ; the centre column contains spark gaps and the two columns flanking it consist of condensers

Welding Heat Flow Problems

A CONFERENCE on heat flow problems, convened by the Institute of Welding, was held at the Selsdon Park Hotel on 16th and 17th May and attended by about twenty investigators drawn from industry, the universities and research associations. There were four sessions, two on each day. The chair at the first two sessions was taken by Professor O. A. Saunders, of Imperial College, and these sessions were devoted to a general exchange of information and ideas with the object of defining the present limits of knowledge and the fields in which further investigation is needed.

The discussions, opened by Mr. H. E. Dixon (British Welding Research Association) and Mr. J. F. Lancaster (A.P.V. Co.), established the importance, especially in the case of the alloy steels and of the aluminium alloys, of making available acceptably reliable methods of calculating the thermal cycles occurring during welding. On the basis of such data the welding engineer is able to predict the physical properties of the finished weld and of the heat-affected zone and so to determine, without long and costly experiments, the welding procedures required to produce a satisfactory joint free from cracks and without excessive distortion.

In opening the third discussion, Dr. A. A. Wells (B.W.R.A.) described the formulæ, devised originally for purposes other than welding, for the calculation of the heat flow in the plate and explained certain simplifications which could be adopted without materially reducing the accuracy of the results.

Other methods of calculation were described by Dr. P. H. Price (Sheffield University) and Dr. A. V. Brancker (Northern Aluminium Co., Ltd.), while Mr. E. V. Beatson gave an account of practical experiments in connection with the resistance welding of carbon steel studs to plate material. A similar contribution, describing experiments conducted at Birmingham University and concerned with the correlation between the thermal effects predicted by the formula developed by Dr. Wells and those observed in the practical tests, was made by Mr. D. R. Milner in the concluding session. Possible improvements in the efficiency of existing measuring equipment were also discussed.

There was general agreement that further work requires to be done both on the theoretical and the practical sides in order to provide the welding engineer with simple and trustworthy methods of calculation. The conference therefore set up a continuation panel to collect and distribute information about work done and projected. Inquiries should be addressed to the Secretary (Heat Flow Panel), Institute of Welding, 2, Buckingham Palace Gardens, London, S.W.1.

Brazilian Electrical Expansion

Plans for Increasing Generating Plant Capacity

From Our Rio Correspondent

PRESIDENT CAFE FILHO announced in his message to Congress in March that Brazil's installed capacity had increased in 1954 by 750,000 kW to a total of 2,848,000 kW. Of the additional plant the Brazilian Traction, Light & Power Co. was responsible for 465,000 kW.

In Sao Paulo plant capacity increased by 245,000 kW last year, bringing the total for this State up to 1,105,223 kW, or 38·8 per cent of that for the whole country. Professor Antonio Cardoso, President of the Sao Paulo Electrical Council, predicts that a further 470,000 kW will be available in 1956, 390,000 kW from six units in the Cubatao underground station and 80,000 kW from the initial installation at Peixoto, on the Rio Grande. Because of the low rainfall 1954 was the most critical year ever experienced by the Sao Paulo Light & Power Co. Strict rationing was introduced, supplies being cut off daily for five hours over a long period, and many factories and business houses installed small generators to supplement the public supply. The position was eased when the Piratininga plant began operating in November and contributed 4·8 million kWh, or more than one-third of the daily consumption. Weather conditions then improved in the Paraiba Valley and the Rio Light & Power Co. was able to reinforce the Sao Paulo supply by up to 5 million kWh daily over the 230 kV link between the two systems. Since restrictions were relaxed Sao Paulo's daily consumption has averaged 13 million kWh.

Last year the Companhia Paulista de Força e Luz installed additional 5,000 and 10,000 kW units in the Jaguari and Americana hydro-electric stations and completed a 30,000 kW thermal plant at Carioba; Força e Luz de Parana brought three new diesel-electric units into service and speeded up work on the Guaricana hydro-electric on the Arrial River; and the Companhia, Brasileira de Energia Electrica started building a 10,000 kW thermal station at Sao Goncalo, State of Rio, to be completed in 1956.

Hydro-Electric Projects

Several State Governments are collaborating with the Federal Water Board in the development of hydraulic power and installation of thermal plant provisionally where needed, pending the completion of permanent hydraulic plants. By 1956 Sao Paulo aims to complete four hydro-electric stations, with a combined capacity of 425,000 kW, on rivers of the Paranapanama Basin; nineteen others, with a total capacity of 1,100,000 kW, are projected for the Tiete River, and the possibilities of the Paraiba Valley are now being examined in co-operation with Brazilian Traction.

In Minas Geraes projects have been started, or are under study, to provide an additional 200,700 kW. In Espirito Santo plans have been approved for four hydro-electric plants with a combined capacity of 103,000 kW.

The World Bank has granted loans, totalling $(U.S.)25 million, to finance projects drawn up by the Brazil-U.S.A. Mixed Commission and approved by the Government in 1952 and 1953; the Export-Import Bank, in turn, advanced the equivalent of £831,400 to Empresas Electricas Brasileiras and, in 1954, the Brazilian Bank for Economic Development authorized a credit of £4,800,000 to the Bahia State Government to build the Funil hydro-electric station.

Brazil's installed capacity increased by 35 per cent in 1954, but the rate will probably not exceed 10 per cent this year, judging by the present state of the works in hand. *Conjuntura Economica* predicts that the next five years will witness spectacular activity in the electrical field, both by official and private enterprises. A total sum of £58,336,000 will be available to finance power production and distribution this year. The Electrification Fund will contribute £39,316,000, to be divided among Federal, State and Municipal Governments in the proportions of 40, 40 and 20 per cent. These funds will be allocated to specific works provided for under the five-year electrification plan.

Additional sums of £3,840,000 and £2,000,000 will be drawn from the funds for economic development of the Amazon and Sao Francisco Basins, created by the 1946 Constitution. The Immigration and Colonization Service will provide £5,150,000, the Public Health Service £5,940,000 and the Department of Anti-Drought Works in North East Brazil £2,120,000. All these amounts are reserved exclusively for improving and increasing electricity supplies in remote regions, served by the Special Commissions, and cannot be diverted to other purposes.

Brazil, in the past, has neglected to develop public services in step with industrial progress and population growth. As a result inadequate transport systems and power supplies are retarding development and provoking irresistible demands for immediate reforms.

Electrical Manufacture

The expanding local market and the prospects of resuming exports to other Latin American countries are encouraging Brazilian manufacturers of electrical materials to increase the volume and range of production. The director of the Sao Paulo Industrial Association recently visited North and South America to study market conditions. He reports that Brazil's prices for electrical household appliances, converted at free market rates, are still higher than those charged by United States manufacturers for the export trade, but not for the domestic market. The difference ranges from 20 to 30 per cent for many articles and cannot be reduced at present in view of the high cost of imported equipment and raw materials. The bulk of such imports are classified as category 2 or 3 merchandise, for which the premiums averaged 26 and 51 cruzeiros per dollar in April last. The gap can only be closed by increasing the export subsidy for manufactured goods, which is already 31·70 cruzeiros per dollar (88·76 per £), or by freeing the exchange for exports.

It was the declared intention of the late Minister of Finance to adopt the latter alternative as soon as free rates could be stabilized at reasonable levels. This, also, is his successor's intention, although the two Ministers hope to reach the same object by different routes. The dollar rate has declined since mid-March and is now relatively steady at 80 cruzeiros, but exporters of manufactured goods receive only 50 for their bills.

Railway Goods Charges

Particulars of the New Scheme

By GRAHAM SAVILLE

THE new charges scheme for railway goods traffic, which has now been submitted by the British Transport Commission to the Transport Tribunal for approval, includes all traffics likely to be handled by electrical concerns. It is designed to take the place of present methods of charging.

It will be recalled that railway goods traffic was charged according to a classification, with the factors of mileage and weight determining the actual charge. This system meant that the traffic of electrical firms, in the main, carried very high charges as its value was usually considerable. The new system does not pay the same regard to the value of the commodity but is more concerned with its "loadability." This term is a somewhat new one; it is defined in the scheme as follows:—

> "Loadability" means, in relation to any consignment, the greatest weight of goods identical in every way (save as to total weight) with the goods comprised in the consignment as tendered for carriage, which is reasonably capable of being loaded and safely carried in an open railway wagon with two axles capable of carrying a maximum load of 10 tons and with a cubic capacity of 450 cubic feet.

Loadability and Mileage

The manner in which this factor of loadability will be allied to the actual charges should be understood and the following summary of the charges scheme shows the manner in which loadability and mileage operate:—

(i) In the case of any consignment of 10 tons or more and having a loadability of 10 tons the charge for the first ten miles or any part thereof is 28s per ton, and for each mile or part of a mile in excess of 10 miles 3¼d per ton.

(ii) For a consignment of 8 tons or more and having a loadability of 8 tons or more the charge for the first 10 miles or any part thereof is 31s per ton, and for each mile or part of a mile in excess of 10 miles 3¼d per ton.

(iii) For a consignment of 6 tons or more and having a loadability of 6 tons or more the charge for the first 10 miles or any part thereof is 39s per ton and for each mile or part of a mile over 4d per ton.

(iv) For a consignment of 4 tons or more and having a loadability of 4 tons or more the respective charges are 54s per ton and 5½d per ton.

(v) For a consignment of 3 tons or more and having a loadability of 3 tons or more the charges are 72s per ton and 7d per ton.

(vi) For a consignment of 2 tons or more and having a loadability of 2 tons or more the charges are 100s per ton and 9d per ton. Provided that in the case of any consignment of a given loadability for which the maximum carriage charge ascertained in accordance with the provisions of sub-paragraphs (i), (ii), (iii), (iv) and (v) is greater than the maximum carriage charge so ascertained for a consignment of a greater weight of the same loadability the maximum carriage charge shall be the charge so ascertained for the consignment of the greater weight.

(vii) (A) Where the consignment exceeds 1 ton in weight respective charges are 160s per ton and 1s 3d per ton; (B) Where the consignment exceeds 10 cwt but does not exceed 1 ton in weight the charge is as under (A), plus 1s per consignment; (C) Where the consignment does not exceed 10 cwt in weight the charge is as under (A), plus 2s 6d per consignment.

As many electrical and allied goods are forwarded in small consignments, the special charges referring to consignments of under one ton should be noted as these could have a considerable effect on the overall charges.

It will be realized that it is essential to know what is actually covered by these charges. The rates are station to station but the Transport Commission indicates that collection and delivery services will be available for many traffics and that the charges will be reasonable. The charges also include the provision of wagons, unless special wagons are required, and the provision of sheets where necessary.

There will be some electrical concerns who have their own private sidings and in this connection it should be understood that the charges will include the delivery or receiving of loaded wagons at the junction of the private siding. Again, with private sidings, an important point is that the minimum weight charged for any consignment delivered or received in a wagon on or at a private siding will be one ton.

Small Consignments

Many consignments of electrical or other goods are in somewhat small quantities and the method of charging for broken weights should be understood. It is provided that any consignment of less than 28 lb shall be reckoned as 28 lb; in any consignment exceeding 28 lb and not exceeding 5 cwt fractions of 14 lb shall be reckoned as 14 lb; in any consignment exceeding 5 cwt and not exceeding 1 ton fractions of 28 lb shall be reckoned as 28 lb; and in any consignment of over 1 ton fractions of 1 cwt shall be reckoned as 1 cwt.

Where the Commission is of the opinion that articles comprising a consignment are such as to involve unreasonable handling, it is entitled to charge for each package or article in the consignment a minimum weight of 14 lb. Electrical firms will, on many occasions, use other services than the straightforward railway transit and in this connection the new scheme makes provision for the Commission to make reasonable charges for certain miscellaneous services and facilities, such as collection and delivery, provision of containers and demurrage.

The whole purpose of the new scheme is to place the railways in a better position to compete with other transport providers and in this connection it has to be realized that many of the legal restrictions such as the publication of rates and the avoidance of undue preference have now been discontinued. The rates outlined are maximum charges and the Commission is able to quote rates below these maxima and it is obvious it is the intention to do this.

In addition, it has been indicated by the Commission that if and when the scheme receives approval, it is not its intention to bring it into operation immediately; a review of rates in various areas will be undertaken and the scheme introduced gradually.

PUBLIC LIGHTING

The Minister of Housing and Local Government sanctioned loans to local authorities totalling £1,149,301 for public lighting during the quarter ended 31st March last.

The BARNSTAPLE Corporation has approved a scheme, estimated to cost £2,531, for the improvement of street lighting in Exeter Road.

BASINGSTOKE Borough Council is applying for consent to borrow £2,533 for the improvement of street lighting on main traffic roads, using fluorescent lamps.

In view of the importance of the Boulevard, BLACKBURN, as a station approach and bus terminus, it was decided to improve on normal street lighting standards, and the new "Osram" 400 W colour-corrected mercury fluorescent lamp was chosen, this being the first application of the lamp for street lighting. Cut-off lighting was desirable on this site, and a G.E.C. lantern with a medium-angle beam distribution was selected. The lamp is burned horizontally without a magnetic deflector. The installation consists of 19 lanterns on double-arm concrete columns, six with 16ft spread and thirteen with 10ft spread. Average spacing between the columns on the through roads is approximately 90ft, extending to 130ft near the bus loading areas at the centre of the Boulevard.

BOLTON Lighting Committee proposes to apply for sanction to borrow £14,940 for improved lighting of main roads and bus routes during 1955-56.

COVENTRY Road Safety Committee has reported that the number of street lamps in the city now totals 8,000, of which over 40 per cent are electric. The City Council is seeking the approval of the Minister of Transport to a gas lighting conversion scheme and the provision of improved lighting in the vicinity of new schools at a total estimated cost of £5,925.

HALIFAX Highways Committee recommends the installation of sodium street lighting along many main streets outside the town centre, which will involve 625 new lighting points and cost £27,631.

IPSWICH Borough Council proposes to provide fluorescent lighting in Northgate Street, Crown Street and Tower Ramparts at a total estimated cost of £1,832.

The LLANDUDNO U.D.C. is seeking sanction to borrow £25,159 for the completion of its scheme for the conversion of public lighting from gas to electricity.

LEIGH Borough Council plans to finance an £80,000 street lighting scheme out of revenue, commencing in the financial year 1956-57. A report to the Council states that the scheme, which is for the conversion of gas and tungsten filament lighting in the borough to Group "B" discharge lighting, would cost £124,000 if subject to loan sanction.

LEYTON Corporation is considering a scheme for the improvement of the street lighting in Seymour Road, and the installation of sodium lighting at the eastern approach to Ruckholt Road Bridge. The estimated cost is £2,500.

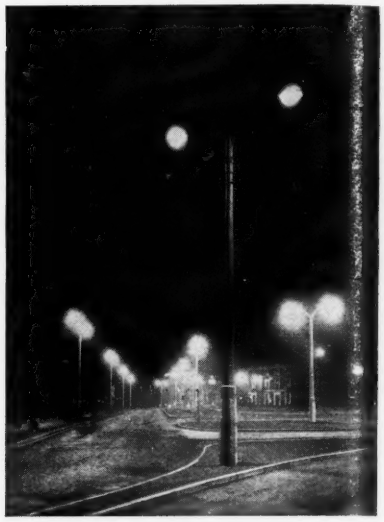
NEWBURY Highways Committee hopes to carry out during the summer a scheme for the provision of standard trunk road lighting in the London Road from Park Way to the borough boundary. The estimated cost is £7,000.

Ministerial approval is being sought to PETERSFIELD R.D.C.'s £4,000 scheme to provide Rowlands Castle and Horndean with electric street lighting.

Loan consent for £3,643 has been given to RAMSGATE Town Council for street lighting on its Newington estate.

RIPON City Council has approved a scheme for the lighting of Mallorie Park Drive, Studley Road, Clotherholme Road, and Kirkby Road in conformity with Ministry of Transport standards, at an estimated cost of £4,866.

SCUNTHORPE Borough Council is considering the setting up of a special street lighting organization, the initial capital cost of which is estimated at £7,200. At present the work is in the hands of the Yorkshire Electricity Board.



Lighting in the Boulevard, Blackburn, is by "Osram" 400 W colour-corrected mercury fluorescent lamps in G.E.C. cut-off lanterns

STRETFORD Borough Council is recommended to apply for consent to borrow £5,233 for part of the third instalment of the Corporation's improved street lighting scheme.

TAUNTON Corporation is to improve the lighting of trunk road A.38 at an estimated cost of £12,650.

WANDSWORTH Borough Council is to install sodium lighting along 56 classified roads and 170 residential roads in the borough.

Electric Furnace Exhibition

In order to give users and potential users in the Midlands an opportunity of seeing the range of electric melting equipment available, the Midlands Electricity Board, in co-operation with Birlec, Ltd., is staging a fortnight's exhibition at its Industrial Showroom, Chester Street, Aston, Birmingham, 6. The exhibition opens on Monday next and will continue until 17th June.

Principal interest in the exhibition will centre on a 35 kW "Birlec Tama" low frequency induction melting furnace which will be engaged, in the showroom, on melting aluminium. Although this size is normally emptied by hoist tilting, the molten metal, for convenience, will be ladled into an E.M.B. diecasting machine for the production of suitable mementoes. The "Birlec Detroit" indirect arc melting furnaces will also be on show. A model LFC has a capacity of 500 lb, while a smaller furnace, rated at 17 kVA and with an average charge capacity of 10 lb, will be arranged for melting duties.

Induction melting will be represented by the smallest of the units available, the 6 kW mercury spark gap set providing power for a 2 lb furnace. There will be a scale working model of a 3-phase direct arc "Lectromelt" furnace and a 30 kW resistance heated pot will also be on show.

South African Tariff Application

The *Board of Trade Journal* reports that the South African Board of Trade and Industries has received an application for an increase in the rates of *ad valorem* duty on electric kettles and elements from 15 to 25 per cent (minimum) and from 20 to 25 per cent (intermediate). United Kingdom manufacturers likely to be affected are advised to get into touch with their trade organizations in the first instance. Inquiries from firms wishing to make independent representations or desiring further information should be addressed to the Commercial Relations and Exports Dept., Board of Trade, Horse Guards Avenue, London, S.W.1, quoting reference C.R.E. 5778/55.

A NEW METHOD OF INTEGRATING

Use of Variable Condenser and Pulse Counting with Wide Applications

By F. H. E. MYERS, M.I.E.E., A.M.I.Mech.E., M.Amer.I.E.E.

FOLLOWING closely on Michael Faraday's discovery of electromagnetic induction, the growth of electrical engineering demanded the invention of means to measure the electrical quantities involved. First of all there were many designs of ammeter and voltmeter, and then the early integrating watt-hour meters.

The watt-hour meters used to-day are very similar to those introduced by Ferranti in 1905 using an induction principle based on Werner von Siemens machine which was constructed in 1855. The integration is performed by a rotating disc driven by the combined fluxes of the current and voltage coils, the speed of rotation depending on the magnitude and phase of these fluxes, and therefore corresponding to the summated energy.

This type of integrator has been, and still is, a very good, compact and relatively cheap device for integrating electrical energy. But it is well known that it is subject to various errors of a parasitic nature as mentioned in Shotter's paper given before the Institution of Electrical Engineers a few years ago, and accuracy of integration changes with variations in voltage, frequency, power factor and temperature. Some designs have quite serious error changes with fluctuating conditions of operation.

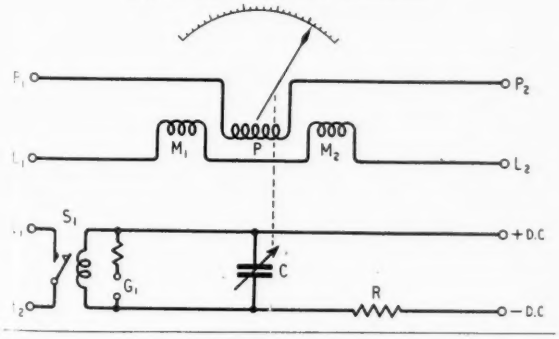
This has led the author to consider using ironless dynamometer wattmeters which have very low, almost negligible, error changes and translate the pointer movement into integration over a given period of time. A new method of integrating any quantity which can be indicated by the movement of a pointer type instrument, as in an electrical instrument, is proposed.

Impulse Integrator

Theoretically, the arrangement of the new type of integrator* consists of an indicating meter with a special spindle which is directly connected to the movable vanes of a variable condenser as shown in Fig. 1. M_1 and M_2 are the current coils and P is the pressure coil of the wattmeter. Coil P drives the vanes of condenser C which is charged through a non-inductive resistance R from a stabilized d.c. source.

The condenser C is discharged at a pre-set voltage by a limiting device at G1, thus imparting an impulse via relay S1 to the circuit t_1 t_2. It will be seen that the number of discharges per second will be in direct proportion to the position of the condenser vane in a circuit with linear characteristic.

Fig. 1.—Basic diagram of connections



*Patent 6412/54.

This means that the impulse rate will be in proportion to the wattmeter reading at any instant, and the total pulses per hour will then correspond with the energy in watt-hours.

Electronic counting systems have been developed, and some detailed consideration of the spindle and bearings for the meter movement and condenser vane is now necessary.

The rate of charging a condenser depends on the time constant of the circuit which, in this case, is a product of capacitance and resistance, and a characteristic charging rate curve is shown in Fig. 2.

The instantaneous voltage across a condenser of capacitance C fed through a resistance R is given by $e=E[1-1/\exp(t/RC)]$ expanding $1/\exp(t/RC)$, we get $e=E[1-1+(t/RC)\ldots.$ and higher terms].

It is essential to keep t/RC small so as to make higher terms negligible, and then the expression simplifies to $e=E(t/RC)$.

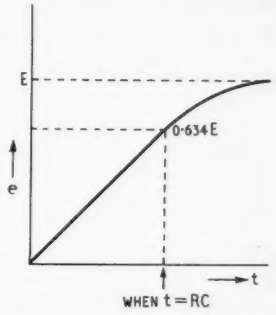


Fig. 2.—Charging characteristics for a condenser in a d.c. circuit

If t/RC is 0·1, the error due to non-linearity may be as much as 5 per cent, and it is necessary to keep t/RC to about 0·01 for 0·5 per cent error. This means that the instantaneous voltage e must not be allowed to exceed one-hundredth of the applied d.c. voltage. One alternative to this requirement is to shape the condenser vanes to match the charge characteristic curve of the RC circuit so as to produce linear response in the impulsing circuit. This has been done for other purposes and could be done for this particular application.

Components and Pulse Rate

High-speed electromechanical registers are usually considered to be positive counters with 100 per cent response, but are limited to pulse rates of about one hundred per second. Electronic counters could be used but accuracy of counting is a prime factor in design. It may even be possible to use the frequency to actuate a counting mechanism.

Let us assume that the condenser vanes need not be shaped and that we can accept a non-linearity error of 0·5 per cent then, $t/RC=0{\cdot}01$. In order to give a reasonable value of R, it will be necessary to have a pulse rate of about 10 kc/s, i.e., $t=0{\cdot}0001$. $\therefore RC=10^{-2}$. Suppose we agree that C could be 1,000 picofarads, then $R=10^{-2}/1000\cdot10^{-12}$ ohms $=10^7$ ohms $=10$ megohms.

This means that a set of wire-wound or stabilized resistors having a value of 10 megohms would be satisfactory. It would be preferable to have a wire-wound design for giving stability in resistance value as this is

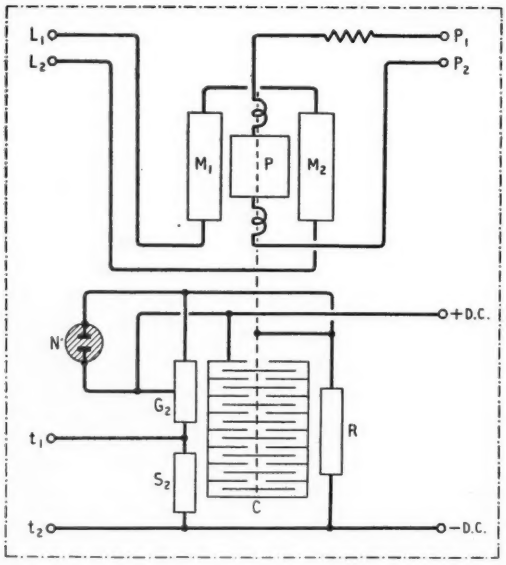


Fig. 3.—Representative circuit diagram

Fig. 4.—Layout for two-wattmeter method of power and energy measurement

most important for timing the pulse. Fig. 3 shows the practical arrangement in which N represents the discharge device, G_2 a germanium triode amplifier and S_2 the pulsing condenser to circuit t_1 t_2 which is connected to the high-speed register.

Fig. 4 shows a layout of metering scheme incorporating impulse integration in which I_1 and I_2 are the integrator circuits driving the registers R_1 R_2 supplied by a power pack PP. It will be noted that the wattmeter scales can also be read for setting the power or to check that it is correct at any instant.

Calibration

Accuracy of time interval measurement is the key to adequate calibration with these impulsing integrators and the time taken to ensure this could be appreciably less than that required for calibrating the orthodox type of integrating meter. For example, to calibrate an impulsing device it would only be necessary to set the wattmeter at a scale mark and to time the pulse rate at that position against a master oscillator which could be checked by a heterodyned frequency sub-division from a quartz crystal source.

It is anticipated that the various errors in the complete arrangement for the integration of electrical energy would be approximately as follows:—

Wattmeter.....	±0·25 per cent
Impulse circuit.....	±0·50 per cent
Stabilized d.c. source.....	±0·10 per cent

If a high-speed electromechanical register can be used there need be no error in counting as these devices are usually considered to be 100 per cent correct. However, if electronic counting or frequency modulation is used there may be further errors which will need consideration, but it is thought these could be calibrated provided drift is negligible.

Other Applications

Although this method of integration has been suggested for the integration of electrical energy, the same principle can be applied to the integration of any quantity which can be measured by an indicating instrument provided there is sufficient torque to drive the condenser vane.

The principle can be used for example, to integrate water flow, gas flow, heat flow, and may even be used for integrating the total energy of atomic reactors and other process work. In each case the quantity can be measured as an electrical signal which can energize a moving coil meter, the spindle of which can be connected directly or magnetically to the integrating condenser vanes.

The author acknowledges permission given by the Central Electricity Authority to publish this article, but the views expressed are entirely his own.

Notes on Applied Science

TWO further publications in the series "Notes on Applied Science" prepared by the National Physical Laboratory have just been issued. No. 10, "Noise Measurement Techniques," discusses the methods, equipment and techniques suitable for noise measurement in varying circumstances. Waveform recording and the principles of broad-band and narrow-band analysis are dealt with in detail. The sections concerned with equipment and its operation cover the characteristics and uses of the various types of microphones, pre-amplifiers, main amplifiers, meters, recorders and analysers. The calibration of microphones and of complete measuring systems and the checking of auxiliary equipment are also described.

No. 12, "The Calibration of Temperature Measuring Instruments," describes the basic scales of temperature and the instruments which are available for making temperature measurements. In the calibration of these instruments it is necessary to decide the temperature scale to be adopted, the degree of accuracy desired and the method and apparatus to be used. The text discusses the factors which must be taken into account in making these decisions. It describes the characteristics of the temperature scale, the realization of fixed points and the routine testing of instruments. The methods and apparatus which are described are mainly those which are used at the N.P.L. for routine checking of accuracy in temperature equipment and in the maintenance of standards of temperature.

A "Stem Exposure Correction Chart (Mercury in Glass Thermometers, Celsius Scale)," designed at the National Physical Laboratory for the easy determination of stem exposure corrections for mercury thermometers, has also been published. It is printed on stout cardboard and carries Celsius (Centigrade) corrections on one side and Fahrenheit on the other. Temperatures up to 500 deg C are covered and corrections from 0·001 deg to 40 deg C are read directly. Examples are given to show how the chart is to be used for all the types of calculation likely to be met in practice.

The notes cost 2s each and the chart 2s 6d from H.M. Stationery Office, postage extra.

Non-Ferrous Metals Research

Work in Progress at the Laboratories

THIS year is the silver jubilee of the establishment in London of the laboratories of the British Non-Ferrous Metals Research Association. To mark the occasion the laboratories were opened to members and others last week, the first guest to inspect them being H.R.H. the Duke of Edinburgh who toured the laboratories with the Hon. R. M. Preston, D.S.O., chairman of the Association's Council from 1950 to 1954.

The Association was among the earliest of the joint research bodies established under the ægis of the Department of Scientific and Industrial Research. It was founded in 1920 in Birmingham and moved in 1930 to its present site near Euston Station; during this period its membership has risen from 20 to 608 and its annual income from £6,000 to £140,000.

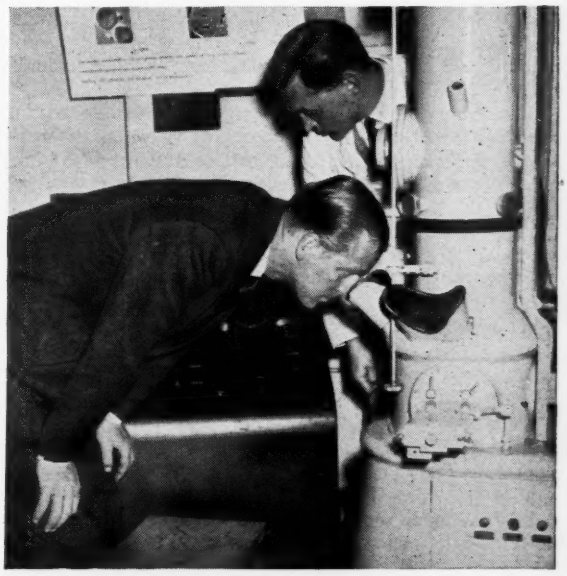
The principal services carried out are research on specific technical problems of members, assistance in applying the results of its own and other researches to the production and use of non-ferrous metals, the distribution of scientific and technical information collected from all over the world, the investigation of difficulties and failures in manufacturing processes and in service, and advice on the production and use of the most suitable materials for particular applications.

The affairs of the Association are controlled by a council which is served by two committees, one for finance and general purposes and the other a board responsible for the programme of research. Aiding the research board are a number of committees from the various industries concerned with specific metals or processes. The total number of staff employed in the laboratories at present is about 157 and their activities are divided into seven sections, i.e., melting and casting, general metallurgy, chemical analysis, physics, corrosion, mechanical testing and metal finishing.

Condenser Tube Corrosion

Among the interesting researches being carried out at the present time is an investigation of the persistent problem of corrosion in condenser tubes. These tubes are made of corrosion-resistant copper alloys and when employed in condensers in ships or in power stations at which sea water cooling is used they suffer from "impingement" attack by air bubbles entrained in the stream of sea water used for cooling. This attack causes deep craters in the tube and eventually perforation of the wall. Earlier research enabled this problem to be largely solved and the emphasis of the work has now shifted to the difficulties being experienced in condenser operation from river estuaries where the cooling water is heavily polluted. In such situations the persistence of hydrogen sulphide is a potent factor in accelerating corrosion.

Experiments are continually being made by copper producers to develop chemical methods of extraction of copper and nickel from the ore. When this method is employed the metal is produced as a fine powder and research is going on in these laboratories to develop a process for rolling thin strip and wire direct from the metal powder, by pouring it into a gap between a pair of rotating rollers and compacting it into a strip strong enough to be handled. After heating and more rolling the strength is similar to that of strip obtained from a cast ingot.



The Duke of Edinburgh looks into an electron microscope at the British Non-Ferrous Metals Research Association's Laboratories

Only thin strip production is contemplated but this could be of considerable use in the electrical industry, especially if the process results in lower cost.

The laboratory is developing titanium alloys suitable for parts of gas-turbine compressors, the rotors of which run at very high speeds, setting up large centrifugal forces. Titanium alloys are useful for the rotor parts because of their lightness and very great strength. Unfortunately this strength only persists at comparatively low temperatures.

Large quantities of non-ferrous metal are used for plating and the quality of electro-plating is something which can vary drastically for uncertain reasons. Two electro-plating lines have been set up in the laboratories and are being run as production plants, plating car bumper-bar overriders. As a result of this work it will be possible to make recommendations to the plating trade for better control of the complicated plating solutions. Another problem associated with this is the inspection of plated parts. It has been very difficult in the past to determine the actual thickness of the coating; a simple instrument has been developed in the laboratories working on a thermo-electric principle and involving the application of a small probe for a few seconds to the part being tested. The thickness of the electro-plating can be read from a meter.

Considerable research is undertaken into the casting of such materials as aluminium, bronze and brass and into the method of casting known as "shell moulding." This enables castings to be made with much greater precision than heretofore. Instead of using sand bonded with clay, the mould is made from a mixture of sand and resin, dumped on to a heated metal pattern plate, when the mixture adjacent to the pattern becomes tacky and binds

together. The surplus is removed leaving a shell of sand about ¼in thick which is hardened by a short baking. Two such shells clamped together form a complete mould and they are very permeable, enabling fine sands to be used to give a very smooth finish.

Among the subjects being investigated at present are the suitability of aluminium alloys for water services, the development of suitable tube materials for use in gas turbine heat exchangers, the improvement of the transverse elongation characteristics of high strength aluminium extrusions, reduction of the lead content of copper, and fundamental research to determine how grain boundaries behave when metals are stressed.

The laboratories have a most comprehensive section devoted to the creep testing and fatigue testing of metal samples. Creep testing can be carried out at temperatures up to 700 deg C the apparatus used being capable of strain measurements up to 2×10^{-5}. For fatigue testing a new short-time machine has been developed which enables assessment of the endurance limit of the material to be made in a matter of 24 hours, compared with several weeks by conventional methods. The system possesses a number of quartz prism spectographs and an ARL production control quantometer specially adapted for analysis of copper alloys fitted with recording apparatus to enable the relative magnitude of any part of the spectrum of the material to be drawn out permanently within a few seconds. These instruments are used continually for analysis of the large numbers of samples resulting from the research programme and members' technical inquiries, and development work to extend the range of spectographic analysis is continually in progress. The laboratories have their own excellently equipped workshops where a great deal of the special apparatus which they require is made up.

Nigerian Railways

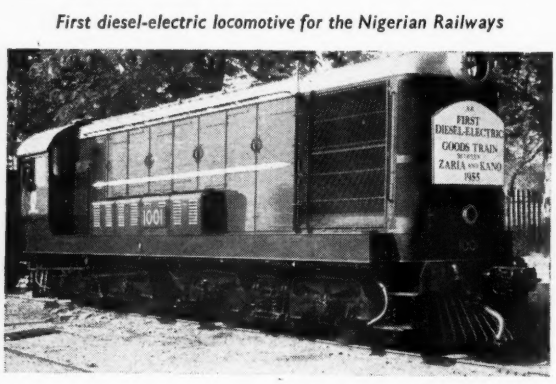
First Diesel-Electric Locomotive in Service

TEN 750 h.p. diesel-electric locomotives are being supplied by the English Electric Co., Ltd., for general service on the 3ft 6in gauge system of the Nigerian Railways. These locomotives, which are the first diesel-electric units to be built for the Nigerian system, will operate singly on shunting and transfer duties, also on the lighter passenger and freight duties, and in multiple units (under the control of one driver) on the heavier main line duties. The first of these went into service last month.

The construction of the 750 h.p. locomotive of 53 tons weight, whilst incorporating cast steel bogies, a medium speed diesel engine and ample fuel tank capacity has been obtained by close attention to design details and may be claimed to be a considerable engineering achievement. The length over the buffer beams is 35ft, the height over the cab roof is 11ft 10in and the overall width just over 9ft. The fuel capacity is 400 gal, the starting tractive effort at 25 per cent adhesion, 30,000 lb and the one hour tractive effort at 9·6 m.p.h., 19,900 lb. The maximum service speed is 55 m.p.h.

The power unit, consisting of the diesel engine, main generator and auxiliary generator, has 3-point suspension and is carried on an all welded underframe. The diesel engine is the English Electric 750 h.p. "in-line" four stroke, pressure charged, six cylinder, S.R.K.T. Mark II type. The engine is started by motoring the main generator from a storage battery. The main generator supplies four traction motors which drive the locomotive wheels through reduction gears and the auxiliary generator supplies current at constant low voltage for the auxiliary equipment. Power output is regulated by the driver by means of one of the two controllers mounted in the cab.

First diesel-electric locomotive for the Nigerian Railways



The bogies are of the four wheel, swing bolster type equipped with two nose suspended, axle hung, traction motors, the frames being one piece steel castings with all brackets cast integrally. The wheels are sprung by means of laminated springs arranged above the axle boxes and fitted with auxiliary coil springs on the spring hanger. The swing bolsters are carried on external swing links.

The locomotive and train brakes are vacuum operated and controlled by the driver's brake valves mounted at each driver's position, a vacuum gauge being provided on each instrument panel. One 24in vacuum brake cylinder is mounted on the outside of the inner headstock of each bogie and operates the rigging through the medium of shafts, levers and trunnions.

The superstructure is divided into three compartments. The leading compartment contains a single panel radiator for cooling the engine water and lubricating oil, with a belt driven fan and electric motor; a motor driven traction motor blower and air filters; and a motor driven air compressor and reservoir. The next compartment contains the power unit, turbo blower and air filters, lubricating oil filters and a portion of the main generator. The third compartment contains the generator and controls including the auxiliary generator, control cubicles, resistances and air filters. Access to the compartments is by hinged doors on both sides of the locomotive.

A 72-cell alkaline battery provides the current for engine starting by motoring the main generator and also supplies the lighting circuits.

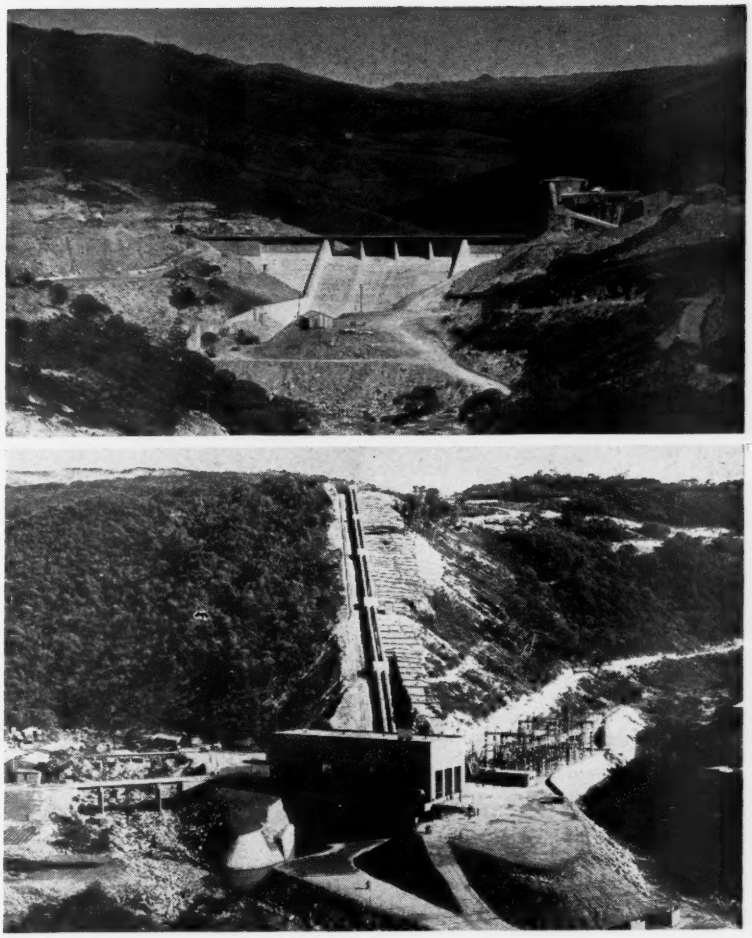
Frequency-Modulation Demonstration

THE new service of broadcasting by the B.B.C. using the frequency-modulation system on very high frequency waves, which was officially inaugurated on 2nd May, has brought the benefits of high-quality interference-free listening to many in the south-eastern counties whose reception of the B.B.C. sound programmes has been badly marred in recent years by interference from continental stations.

In order to explain the benefits of the new system to the listening public, the reasons for its introduction, and the circumstances in which it is of the greatest value, a special demonstration has been arranged at the Science Museum and will remain open for about three months. Comparative recordings will be demonstrated and the operation of a modern commercial f.m. broadcast receiver explained.

The Science Museum is open on weekdays from 10 a.m. to 6 p.m. and on Sundays from 2.30 to 6 p.m.; admission is free.

GENERATION AND DEVELOPMENT



Top: General view of the Guthega Dam in the Snowy River system, Australia. Below: The Munyang power station fed by a 3¼ mile tunnel from the Guthega Dam, with the switching station in the rear

Power for Cornish Industries

During a visit last week to Cornwall Mr. S. F. Steward, the chairman of the South Western Electricity Board, inspected engineering works which are being carried out to augment power supplies for local industries. One industrial centre of growing importance is Par Harbour, in South Cornwall (district manager, Mr. J. E. Flower). Here a new 11 kV substation has been built and a high voltage line is to be erected to link the harbour with the Board's supply network at St. Blazey and St. Austell. Par Harbour first received electricity in 1933 when a low voltage supply was extended to provide lighting for the harbour and offices. Later, power began to be used for stone crushing and for harbour cranes. To-day the three major industries—stone crushing, china clay processing and the repair of railway wagons—are highly mechanized, and electric motors totalling 2,000 h.p. will soon be in use.

Cornwall Mills, Ltd., have a large plant for the grinding of hard stone, including china stone, felspar and quartz, for use in glass manufacture, enamelling and for scouring powders. The plant is fully automatic. Electricity is used for driving the crushers, vibrating screens, conveyors, elevators and a rotary pebble mill 8ft in diameter in which the hard stone is reduced to a powder finer than flour. In addition a new processing plant of the Inveresk China Clay Co., Ltd., is expected to use electric motors totalling about 200 h.p. when in full production. This plant will process china clay from the company's pit at Bodelva, near St. Austell, and the whole output will go to paper mills in various parts of the country. The Electricity Board is also augmenting the supply to the Goonvean China Clay & Stone Co., Ltd.

In East Cornwall (district manager, Mr. L. Locker) a new power supply has been taken to the Launceston Granite Co.'s Greystones Quarry, near Launceston, where electric motors totalling more than 500 h.p. have been installed. Apart from driving the crushing machines, vibrators, elevators, conveyor belts and compressors, electricity is used to heat bulk containers, holding altogether about 8,000 gal of tar or bitumen, and to pump the hot tar to power-driven mixers where graded stones are added to make tarmacadam. The quarry will later have its own laboratory with electrically heated test ovens. A new 11 kV line is being erected across part of Bodmin Moor to provide a mains supply to the Parson's Park China Clay Works of English China Clays, Ltd., near St. Neot. In the Lezant area the Board is planning a £17,000 scheme to take electricity for the first time to rural communities at Lezant, Little Comfort, Rezare and Treburley.

Sydney Commercial Tariffs

Sydney County Council, New South Wales, has decided to reduce commercial electricity charges by £275,000 a year from 1st May. Commercial users are to be offered a block tariff, six existing special rates being abolished. These are cooking "B," night sports, process heating (restricted), process heating h.v., special lighting and ship, and a.c. lift. The block tariff will be: First 150 kWh a quarter, 7d/kWh; next 450, 5½d/kWh; next 14,400, 4¾d/kWh; and all in excess at 4d/kWh.

In a report to the Council, the general manager, Mr. C. E. Ranger, said the new system would benefit 19,418 of the Council's 24,000 commercial customers. Those who would not benefit could remain on the present tariff basis; they would have twelve months to decide which they preferred. Abolition of the special rates would simplify administration and allow future reductions to be applied more speedily.

The commercial rate reductions follow domestic tariff concessions costing £380,000 a year which came into force on 1st February. Industrial reductions costing £203,000 a year also came into force on 1st May.

Electricity in Finland

The International Bank for Reconstruction and Development has recently granted a $12 million loan to the Bank of Finland, about $4 million of which will be used for the further development of the country's power supply system. The loan will be used to pay for turbines, generators, switchgear and other equipment. The water power resources remaining to be developed in Finland are for the most part situated in the northern part of the country. Although they can

produce power economically, heavy capital investment is needed for the construction of dams and long transmission lines to the main consuming centres, which are mostly situated in the south. Thermal power capacity also needs to be expanded to guarantee a steady supply of electricity when the water flow is low.

One development is at Petajaskoski, on the Kemi River, in northern Finland, where two 50,000 kW generating units will be installed with provision for a third. Construction was actually started early in 1953 and the first unit is scheduled to start working at the beginning of 1957. A thermal station of 30,000 kW in western Finland should be ready in the second half of 1957.

South of Scotland Consultative Council

Mr. James Stuart, Secretary of State for Scotland, has appointed the Electricity Consultative Council for the South of Scotland District. Fourteen members of the Council represent local authority interests and fourteen represent the interests of agriculture, commerce, industry, labour and the general interests of consumers of electricity. As has already been announced, the chairman of the Council is Bailie John Sullivan, of Glasgow, who is a member of the South of Scotland Board. Mr. M. I. H. Mackenzie-Inglis, J.P., a member of Midlothian County Council, has been appointed deputy chairman. The other members of the Council include Mr. G. S. Helme, T.D., A.M.I.E.E. (Lancashire Dynamo & Crypto, Ltd.) and Mr. J. Jamieson, B.Sc., M.I.E.E., A.M.I.Mech.E., M.I.H.V.E. (Bastian & Allen, Ltd.).

Midland Board's £900,000 Programme

Nearly £900,000 is to be spent on the development and reinforcement of electricity supplies in the Midlands Electricity Board's Shropshire and Herefordshire Sub-Area during the current financial year, including £421,000 on rural development and new housing. Of the £421,000 for rural development and new housing, upwards of £50,000 is to be devoted to the connection of more than 1,600 new houses in urban areas. The remainder is for the rural electrification programme, the pace of which is to be increased by putting out to contract not only the overhead line construction work but also some of the preliminary work, such as surveying and the completion of agreements with prospective consumers. The programme provides for the connection of 2,788 rural premises, including 553 farms, and when completed it will bring the Sub-Area's total of farms on supply to more than 5,000.

Details of the plans were given recently by the Sub-Area manager, Mr. W. Winwood, at a meeting of the Shropshire and Herefordshire Local Committee of the Consultative Council. Mr. Winwood's report revealed that farms connected in the Sub-Area now total 4,500 compared with just over 2,000 when the Board was established in 1948.

To meet the growing demand, the Sub-Area engineer, Mr. G. W. J. Newey, and his staff, have in hand this year a large programme of system improvement and reinforcement, and to speed up the work some schemes are to be carried out by contractors. To augment supplies in the Shrewsbury District a new 33 kV line is to be erected from Ironbridge generating station to Weir Hill, Shrewsbury, and a new major high voltage transformer substation is to be commissioned at an estimated cost of £59,000. In the Wellington District there is a £92,000 scheme providing for a substantial increase in the capacity of a major substation, and the erection of nearly six miles of 33 kV line from Ironbridge to Hadley, to supplement existing high voltage supplies to this heavily industrialized area. In the Ludlow District, work has recently begun on the erection of 8½ miles of 33 kV overhead line from Squirrel Lane substation to Craven Arms, affecting the Church Stretton and Bishops Castle areas. In the Leominster District a £38,000 scheme provides for ten miles of 33 kV line from Tenbury Wells to Leominster, and a new major substation, and in the Hereford District a new 132 kV substation is to be erected in the next two or three years in the vicinity of Hereford.

Cookers and Washers on Housing Estate

Following representations by the North Eastern Electricity Board, the Boldon (Co. Durham) U.D.C. has rescinded its decision not to install electric cookers and wash boilers in new houses on the Boldon housing estate. The Council has now decided to install these facilities in 50 per cent of the houses on Section 4 of the estate.

Special Tariff

Ramsgate Borough Council has been recommended to take advantage of a special tariff submitted by the South Eastern Electricity Board by which electricity rates are reduced at week-ends and in the summer.

Council House Installations

Oxford City Council is planning the improvement of the standard of lighting in 256 houses at an estimated cost of £3,500.

Turkish Water Power Project

Work has started on the construction of a large dam and hydro-electric power station at Demirköprü, on the Gediz River, north of Izmir, Western Turkey. This plant, one of the major units in the Turkish grid, will cost about £T200 million. Planned by a New York firm of consulting engineers, the contracts for the new project were awarded to a Franco-Turkish enterprise. When ready for operation in April, 1958, its 70,000 kW plant will generate 190 million kWh per annum, provide water to irrigate over 100,000 hectares of agricultural land and control floods in the Gediz Valley.

Venezuelan Power Plant Completed

With the installation of the fourth turbine at the Arrecifes electric power plant, west of La Guaira, the large project of the Caracas Electricity Co., costing about £6,500,000, has been completed. Its capacity is 196,000 kW, leaving a reserve of 66,000 kW over and above the present demand of 130,000 kW. In the same locality the company is erecting another plant with total capacity of 360,000 kW, and when completed, about 1960, it should be sufficient to meet the steadily growing demand in the capital and vicinity, including numerous new industries and extensions. Several new electric power plants have started operation recently, the most important in the interior being that of San Cristóbal (Táchira) in December last. The Venezuelan Development Corporation has invested nearly £20,000,000 in financing eighteen electric power companies.

Transport in Ceylon

In a report on the Ceylon Government Railways, Mr. F. C. Bhadwar, an Indian railway expert, says that if they are to be run as a paying concern, electrification is necessary. He recommends that for a start electric trains should be introduced on the lines where traffic is heavy.

Five diesel-electric locomotives were recently delivered to the Ceylon Government by Canada under the Colombo Plan. At the handing-over ceremony at Colombo railway station by the Canadian High Commissioner (Mr. J. J. Hurley) to the Prime Minister of Ceylon (Sir John Kotelawala), the Minister of Transport (Mr. Jayawickreme) said that as a token of the Ceylon Government's gratitude the five locomotives had been named Columbia, Alberta, Saskatchewan, Ontario and Quebec.

STAGE LIGHTING CONFERENCE

The South Wales Electricity Board is holding a conference and demonstration on the latest techniques of stage and auditorium lighting at its demonstration theatre, The Hayes, Cardiff, from 13th to 15th June. Invitations have been sent to interested parties, and special demonstrations have been arranged for South Wales members of the Electrical Association for Women (15th June) and the Electrical Contractors' Association (16th June). For the purpose of the demonstration a local store is arranging a fashion display.

Financial Section

STOCKS and SHARES

IN the Stock Exchange, first reactions to the General Election were somewhat modified by the fact that the result had been confidently anticipated, as was witnessed by the large and sustained rises in industrial share prices which preceded the event. Consequently, the volume of business released by it was of no one-way character. On the buying side, evidence developed of a big investment demand, pent up previously by the element of uncertainty. This met, from the other side, a certain amount of selling of shares bought beforehand. As the first bout of excitement subsided, it quickly appeared that business and buyers were returning in an atmosphere of renewed "bullishness." Particularly firm features were apparent, of course, among the shares of companies in the steel industry and others earmarked for public ownership in the Labour programme. But except for dullness in gilt-edged stocks, the first result of the General Election was decidedly favourable, in spite of the caution induced by the threat of strikes.

Initial Reactions

In mentioning some of the price changes in the electrical equipment market, it has to be noted that these represented only initial reactions to the Election result, and that large day-to-day movements are occurring. The comparison with prices at the beginning of May shows the extent to which in many cases the outcome had been anticipated:—

Ordinary Share	May		
	2nd	26th	27th
A.E.I.	72/3	74/6	76/–
B.I.C.C.	47/–	49/6	49/9
Cole, E. K.	19/3	23/–	23/6
Crompton Parkinson	16/6	17/9	17/10½
Decca	33/6	39/6	40/3
E.M.I.	28/6	30/6	31/9
English Elec.	64/–	70/3	71/6
G.E.C....	56/3	60/–	61/6
Parsons	63/6	87/–	90/–
Reyrolle	91/6	108/–	111/–
Westinghouse ...	97/6	99/6	100/–

Cable Conditions

Mr. McFadzean's review circulated with the annual report of British Insulated Callender's Cables confirms the impression left by other reports from the cable industry that trading conditions during 1954 improved as the year progressed. After a quiet opening, activity gathered momentum until, at the end of the period, B.I.C.C. were working considerable overtime. This unevenness of the load, coupled with intensified competition, contributed mainly to the reduction in profit rates, and thus to the decline in the trading surplus from £8·3 to £7·4 million, despite the maintenance of the group's turnover. Regarding the outlook, the chairman speaks of a good start to 1955 and looks forward, in the absence of exceptional happenings, to a satisfactory year.

Dividends Declared

Among recent company results to make a good market impression was the announcement by John Thompson of a final distribution of 10 per cent (including a bonus of 5 per cent). This goes to capital increased by a three-for-five scrip issue since the payment of the 10 per cent interim. Net profit of the group, which is associated with A.E.I. in atomic power development work, is up from £413,000 to £778,000. Southern Areas and Heatrae also report higher earnings and are raising their total distributions respectively from 7½ to 10 per cent, and from 12½ to 15 per cent.

June Dividends

Since last year, Electric Construction have made a one-for-one scrip issue, and the recent quotation of the shares on a yield basis of under 4½ per cent seems to reflect hopes of a sequel in the shape of a larger dividend declaration this month. A yield of around 5 per cent has been showing on Aron Meter shares, holders of which were advised in last year's report that the figures for 1953/54 were not likely to be equalled during the period which has now ended. Other companies which closed their books in March, and last time produced the results in June, include Ekco, Vactric, Revo, Hackbridge & Hewittic, and Marryat & Scott.

Pressed Steel

While the Pressed Steel Company's name is associated in the investment mind mainly with car bodies, the recent announcement of the contract for some 27,500 railway wagons served to draw attention to the diversity of the group's products, which, of course, also include refrigerators. The 5s shares have been a firm market since the publication of the 1954 results. Group trading profits showed no great change, but, with the elimination of previously heavy charges on account of the excess profits levy, the net surplus came out 40 per cent higher at £1·4 million. This represented earnings of 75 per cent gross on the ordinary capital, and covered amply the increase in the dividend from 17½ to 22½ per cent.

Powers-Samas

Owning already about two-thirds of the Powers-Samas Accounting Machines ordinary capital, Vickers are inviting holders of the million odd publicly-held shares to exchange them for Vickers ordinary shares, in the proportion of three of the latter, plus 6s in cash, for every two Powers-Samas shares held. The offer is open until 8th June, or such later date as Vickers may decide. The effect of the invitation has been to raise Powers-Samas shares substantially above their previous level, bringing the quotation into correspondence with the value of the offer in relation to the price of Vickers ordinary.

Results to Come

Now that annual results have been declared by most of the companies whose financial years end with the calendar, the industrial market's flush season of dividends and profits statements is drawing to a close. On a smaller scale, however, the running is taken up about now by the numerous companies which close their books in March. Two of them due about now to report for that period are Electric Construction and Aron Electricity Meter. Both adopt the practice of making a single annual payment. In each case, the rate a year ago was 15 per cent, paid from earnings equivalent, respectively, to 42 and 63 per cent on the ordinary capital ranking.

NEW COMPANIES

J. H. Humphreys & Sons, Ltd.—Registered 2nd May. Capital £100,000. Manufacturers of electro-magnetic chucks and apparatus and equipment; electrical and mechanical engineers, etc. Solicitors: Parker Warskett & Chapman, Sheffield.

K. Dykes, Ltd.—Registered 5th May. Capital £10,000. Electricians, mechanical engineers and manufacturers, workers and dealers in electrical apparatus, radios, etc. Solicitors: Close & Son, 95, High Street, Camberley.

W. H. Dolby, Ltd.—Registered 30th April. Capital £5,000. Electrical contractors, dealers in electrical appliances, radio and television sets, etc. Directors: W. H. Dolby and Mrs. Rebecca Dolby. Regd. office: 266, Wallasey Village, Wallasey, Ches.

Ridge Electrical Agencies, Ltd.—Registered 12th May. Capital £500. Agents for manufacturers of general electrical and other equipment and appliances, etc. Directors: N. C. Ridge and Herta M. C. Ridge. Regd. office: 3, Abchurch Yard, E.C.4.

John Tanner, Ltd.—Registered 14th May. Capital £10,000. Radio, television, telephonic and telegraphic engineers, etc. Directors: J. A. Tanner and Irene A. Tanner. Regd. office: 9, Green Street, Warrington.

W. A. Cowie (Electrical) Co., Ltd.—Registered 11th May. Capital £5,000. Manufacturers of and dealers in general electric goods, etc. Directors: W. A. Cowie and Mrs. Jose Cowie. Regd. office: 1, Henry Street, Warrington.

REPORTS and DIVIDENDS

Laurence, Scott & Electromotors, Ltd.—The annual meeting was held on 25th May, Mr. G. H. Wilson (chairman and managing director) presiding. In his statement, which was circulated with the report and accounts, the chairman said that in his review last year he drew attention to the fact that output had overtaken incoming orders for the first time since the war. From the middle of the year onwards the volume of orders took a strong upward turn, including some large export contracts. Their chief strength in the battle for exports was the reliability and technical superiority of their products, which must be backed by increased production to off-set the customers' insistence on firm prices. For almost three years they had been absorbing these cost increases without any substantial increase in selling prices, but the last wage advance, coupled with the increased cost of almost all materials and services, was of a magnitude that was bound to involve price increases in most directions, as it was clear that cost increases were outstripping the most optimistic expectations of increased production. The road to higher productivity lay in the direction of seeking greater production per man-hour worked, and with this in mind they had introduced various schemes of incentives during the year with a view to covering those employees who, by reason of the fact that their individual efforts could not be directly measured, would otherwise not have a personal financial incentive.

Referring to the capital commitments of £320,000 on which they had embarked, Mr. Wilson said a large part of this sum would be spent on new office accommodation at the Norwich works. The great increase in the cost of plant replacements accounted for the proposed allocation of £100,000 to plant replacement reserve. Mr. Wilson referred to some of the more interesting orders carried out during the year.

The Harland Engineering Co., Ltd.—The accounts for 1954 show a consolidated trading profit of £275,373, as compared with £205,262 for 1953, and after meeting all charges, including £127,979 for taxation, the net balance is £99,555 (against £69,487), of which £90,290 is attributable to the parent company. General reserve receives £50,000 and it is proposed to pay an ordinary dividend for the year of 14 per cent (against 11 per cent). The balance carried forward is £53,567 (against £51,677 brought in).

In his accompanying statement, Mr. H. Cowan-Douglas (chairman) says that orders in hand at the end of the year were valued at approximately £2,165,000. Although this figure is £500,000 below that at the end of 1953, the work in hand will ensure full activity for some fifteen months ahead. Output by the Water Turbine Department during the year has reduced the volume of work in hand to the extent that new orders, with reduced dispatch times, can now be energetically pursued. Continuous development has been applied throughout the year with a view to lowering the cost of the more standard products and for new plant for large thermal power stations now projected. They are also undertaking research work in connection with various applications for atomic power generation.

The Sturtevant Engineering Co., Ltd.—The annual meeting was held on 23rd May. In his circulated statement, Mr. G. R. Thursfield (chairman) said that they had been working to full capacity practically the whole of the year under review. Although every effort was being made to expand the export business, they were still handicapped by import restrictions imposed by some countries. The new works extensions referred to last year were now in commission and additions had been made to equipment. They were still faced with a shortage of skilled labour, and certain classes of steel were in short supply. They still had a satisfactory order book which would keep them fully occupied for many months.

Heatrae, Ltd.—The net profit for the year to 28th February last was £16,070, as compared with £10,529 for the preceding year. Taxation absorbed £14,750. Stock reserve receives £10,000 and it is proposed to pay a dividend for the year of 15 per cent (against 12½ per cent). The balance carried forward is £25,969 (against £25,036 brought in).

The West London & Provincial Electric & General Trust, Ltd.—The net balance for the year ended 31st March last, after providing £31,307 for taxation, is £39,111, as compared with £31,180 for 1953-54. It is proposed to pay a final dividend of 10 per cent and a bonus of 2 per cent (against 6 per cent and bonus of 2 per cent), making 16 per cent for the year (against 12 per cent).

John Thompson, Ltd., reports a group profit of £2,049,591 for 1954, as compared with £1,472,760 for 1953. After meeting all charges, including £954,464 for taxation, the net balance is £777,586 (against £413,168). An interim dividend of 10 per cent was paid on £1,146,599 capital, and it is now proposed to pay a final ordinary dividend of 10 per cent, and a bonus of 5 per cent on capital of £1,834,399 as increased by a 60 per cent scrip issue. For 1953, the distribution on capital of £859,949 was 22½ per cent. It is also proposed to give a bonus of one week's basic pay to staff and workpeople, which is approximately equal to the 5 per cent bonus to stockholders.

The directors state that orders on hand uninvoiced at the present time are £38 million, an increase of £1,500,000 over the corresponding figure for last year, in spite of additional output.

The Calcutta Electric Supply Corporation, Ltd., proposes to pay a final dividend of 3 per cent, maintaining the distribution for 1954 at 6 per cent, tax free. The gross revenue amounts to £5,291,657, as compared with £4,996,114 for 1953, and expenditure is £3,898,066 (against £3,785,376). Debenture interest requires £225,172, and debenture sinking funds £112,702. Retiring gratuity fund receives £35,000, contingency reserve £70,978, taxation £95,000, and special appropriations £492,223. The balance carried forward is £152,818 (against £157,731 brought in).

Crompton Parkinson, Ltd., has declared an interim dividend of 4 per cent on the ordinary stock. The ordinary stock was increased at the end of December last by a distribution of one new stock unit for every four held. The dividend now declared is therefore equivalent to the interim dividend of 5 per cent paid last year.

Louis G. Ford, Ltd.—The accounts for 1954 show a group net profit of £53,843, as compared with £36,736 for 1953. It is proposed to pay a final ordinary dividend of 10 per cent, and a bonus of 2½ per cent, making 17½ per cent for the year.

In his accompanying statement, Mr. L. G. Ford (chairman and managing director) says that their wholly owned subsidiary company, Ford Wholesale Electric, Ltd., continued to contribute in fair measure. The volume of trade for the first three months of 1955 exceeded that for the corresponding period of 1954.

Bankruptcies

D. G. Edwards, 8, Blackfriars Road, Newcastle-under-Lyme, electrical engineer.—Order made 20th April refusing bankrupt's discharge.

D. Cunningham and **A. E. Beacock,** carrying on business in co-partnership at 39-40, Trevelyan Chambers, Boar Lane, Leeds, under the style of the Home Electrical Maintenance Co., electrical maintenance service engineers.—Last day for receiving proofs for dividend 4th June. Trustee, Mr. W. H. Meredith, 29, East Parade, Leeds, 1, Official Receiver.

Liquidation

A. T. Snowden, Ltd., radio and electrical dealers.—Winding up voluntarily. Liquidator, Mr. L. Larholt, Cunnynhame House, Cunningham Hill Road, St. Albans, Herts, appointed 20th May.

Netherlands Electrical Trade

Large Increase in Imports

Electrical imports into the Netherlands last year totalled Gld.413 million, an advance of over one-third on 1953. The accompanying table shows the values and principal supplying countries of the main groups in 1954 with notes of increases or decreases on 1953. It will be seen that the country's electrical purchases from abroad were bigger in every group except transformers over 10 kg., and that outstanding increases were recorded in radio receiving apparatus from Belgium and West Germany, and wires and cables. On the whole the share of the United Kingdom was fairly well maintained, while West Germany made progress in all lines save accumulators.

Class of Goods	1954 Gld. (000)	Inc.or dec. on 1953 Gld. (000)
IMPORTS		
Motors, 10 kg. or less ...	3,118	+ 332
From U.K....	1,422	− 49
West Germany ...	1,026	+ 502
Motors over 10 kg.	18,290	+ 1,595
From Belgium-Luxemburg	2,556	− 70
,, *U.K....*	3,286	+ 85
,, *France*	1,093	+ 807
,, *West Germany* ...	8,112	+ 1,343
Transformers 10 kg. or less ...	2,487	+ 944
From Belgium-Luxemburg	1,299	+ 550
,, *U.K....*	328	+ 123
,, *West Germany* ...	513	+ 186
Transformers over 10 kg. ...	9,767	− 4,220
From Belgium-Luxemburg	1,324	− 1,604
,, *U.K....*	760	− 501
,, *France*	2,299	− 511
,, *West Germany* ...	2,897	+ 256
,, *Switzerland...* ...	2,167	− 94
Static convertors over 10 kg.	2,294	+ 683
From U.K....	1,021	+ 290
,, *West Germany* ...	570	+ 179
Accumulators	6,217	+ 572
From Belgium-Luxemburg	1,412	+ 500
,, *West Germany* ...	408	− 221
,, *U.K....*	998	− 373
,, *Sweden*	3,029	+ 555
Vacuum cleaners and parts ...	4,405	+ 1,477
From U.K.	1,071	+ 196
,, *Sweden*	1,398	+ 411
,, *West Germany* ...	1,457	+ 506
Electromedical apparatus ...	5,899	+ 1,736
From U.K....	846	+ 359
,, *West Germany* ...	2,745	+ 1,177
,, *Italy...*	709	+ 45
Radio receiving apparatus ...	88,935	+ 33,574
From Belgium-Luxemburg	58,150	+ 17,398
,, *West Germany* ...	28,958	+ 17,984
Radio valves	24,796	+ 6,151
From Belgium-Luxemburg	9,116	+ 2,389
,, *U.K....*	4,694	+ 1,700
,, *West Germany* ...	7,070	+ 4,302
,, *U.S.A.*	1,063	− 1,715
,, *France*	1,130	− 147
Telephone apparatus... ...	19,937	+ 2,317
From Belgium-Luxemburg	7,112	+ 1,558
,, *U.K.*	1,759	+ 1,043
,, *West Germany* ...	1,987	+ 223
,, *Sweden*	4,645	− 1,772
,, *Switzerland...* ...	3,642	+ 922
Insulated wire and cable ...	24,007	+ 8,162
From Belgium-Luxemburg	9,394	+ 3,907
,, *West Germany* ...	9,550	+ 3,963
,, *U.K....*	2,905	+ 1,043
Dynamos and rotary convertors over 10 kg. ...	34,412	+ 5,884
From Belgium-Luxemburg	2,961	+ 49
,, *U.K....*	6,898	+ 1,914
,, *France*	7,713	+ 586
,, *West Germany* ...	10,299	+ 6,041
,, *Switzerland...* ...	4,988	− 678
EXPORTS		
Motors 10 kg. or less... ...	1,880	+ 486
Motors over 10 kg.	4,635	− 705
Static convertors 10 kg. or less	3,576	+ 527
Static convertors over 10 kg.	3,079	+ 1,217
Vacuum cleaners and parts ...	12,550	+ 2,212
Lamps, m.f.	31,502	+ 6,026
Radio valves	99,934	+ 27,114
Radio receiving apparatus ...	170,974	+ 38,252
Telephone apparatus... ...	12,380	− 780
Loudspeakers, microphones, etc.	3,144	− 1,076
Current regulating and control apparatus	12,304	+ 1,672

Belgian Imports and Exports

Belgium's import trade in electrical goods last year rose in value to B.fr.3,766 million compared with B.fr.3,360 million in 1953 and exceeded exports by about one-fifth. The latter were valued at B.fr.3,170 million against B.fr.3,322 million. The trend in 1953 also was towards increased imports combined with a shrinkage in exports.

The accompanying table shows the principal supplying and customer countries in the trade as a whole. It will be seen that West Germany and the Netherlands between them furnished more than half Belgium's requirements while the share of the United Kingdom was less than one-tenth. On the export side the Netherlands remained the predominant market and the Belgian Congo was, as usual, an important outlet. At the same time the U.S.S.R., although taking a considerable quantity of cable and wire was a far less active buyer than in 1953. Telephone apparatus made up nearly 25 per cent of Belgium's electrical exports, with cable and wire not far behind. Telephone apparatus led, too, among imports, mainly from West Germany and the Netherlands. Imports of motors above 10 kg. were approximately equal in value to exports. (B.fr.140=£1.)

Countries	1954 B.fr. (000)	Inc. or dec. on 1953 B.fr. (000)
EXPORTS		
Total	3,170,000	− 152,000
To France	160,000	− 15,000
,, *Netherlands* ...	1,302,000	+ 384,000
,, *U.K.*	15,000	+ 5,000
,, *Belgian Congo* ...	525,000	− 19,000
,, *U.S.S.R.*	171,000	− 134,000
IMPORTS		
Total	3,766,000	+ 400,000
From West Germany...	1,155,000	+ 264,000
,, *France*	323,000	− 18,000
,, *Netherlands* ...	909,000	+ 167,000
,, *U.K.*	342,000	− 70,000
,, *Switzerland* ...	314,000	+ 61,000
,, *U.S.A.*	528,000	+ 19,000

Netherlands electrical exports last year amounted to nearly 25 per cent more in value than in 1953. Out of the total of Gld.601 million the radio trade accounted for about Gld.271 million. The table shows increases or decreases of the chief groups on 1953. Details of distribution are not available (10·61 guilders=£1).

Swiss Electrical Standards

The Commercial Department of the British Embassy at Berne has informed the Export Services Branch of the Board of Trade that it has for some time been understood that the approval of the Schweiz Electrotechnischer Verein (S.E.V.), Zurich, was necessary before electrical goods could be sold in Switzerland and that the standards applied by the S.E.V. were given the force of law as from 1st July, 1954. As there have been conflicting opinions and statements on this subject the position has now been clarified as follows:—

All electrical goods have been divided into two categories—A and B. Only goods in A, which consists entirely of electrical installation material, are forbidden by law to be sold without prior approval by the S.E.V. So far no standards of safety for any electrical equipment whatever have been laid down. Goods in A, however, are tested under the existing standards for quality, which are held adequately to cover safety and this procedure will continue until safety standards have been fixed, or, at the latest, until the end of 1956.

Goods in B and its addenda (which are being added to daily) include all other electrical equipment and may be offered freely for sale to the public. Such equipment must however be submitted within certain defined periods (in most cases two to three years) to the S.E.V. for approval. If at the end of the period laid down (in most cases not until 1st July, 1957) the security mark of the S.E.V.'s approval has not been obtained the material will not be allowed to be sold. A copy of the relevant S.E.V. regulations (in French) is available for inspection in Room 805 at Export Services Branch, Lacon House, Theobalds Road, London, W.C.2. (Reference C.R.E. 4653/55 should be quoted.)

Japanese Power Development

The Government of Japan has drafted a five-year development plan with a view to mitigating the present power shortage. Japan's power potential is 22,000,000 kW of which only about one-third has so far been harnessed. Most of the existing hydro-electric stations are of the run-of-river type but in the new plan emphasis is placed on the erection of storage type stations. The programme envisaged in this new plan is expected to cost about $(U.S.)2,100 million.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (3s 0d each including postage) will be obtainable after 6th July from the Patent Office, 25, Southampton Buildings, London, W.C.2.

1950

2905. British Broadcasting Corporation, and Taylor, J. C.—Indicator circuits. 2nd February, 1951. (733141.)

25281. British Thomson-Houston Co., Ltd.—Heat resisting structures. 16th October, 1951. (733061.)

25665. Cossor, Ltd., A. C.—Magnetic line scan deflection circuits for television receivers. 22nd October, 1951. (733143.)

1951

26033. Parsons, Ltd., C. H., and Handley, G. B.—Electric switches having interlocking means co-operating with electric plug-and-socket couplings. 6th November, 1952. Addition to 609840. (733222.)

27203. Benjamin Electric, Ltd., and Campbell, G.—Electric lighting fittings. 20th November, 1952. (733153.)

28641. Brush Electrical Engineering Co., Ltd.—Hydraulic operating means for electrical switchgear. 5th December, 1952. (733155.)

28811. Electric & Musical Industries, Ltd.—Levelling circuits. 8th December, 1952. (733066.)

1952

995. Parsons, Ltd., C. H., and Handley, G. B.—Electric mercury switches. 19th November, 1952. (733226.)

1985. British Thomson-Houston Co., Ltd.—High tension magnetos. 3rd November, 1952. (733158.)

4293. Busche-Jaeger Dürener Metallwerke Akt.-Ges.—Rotary electric switches. 18th February, 1952. (732971.)

5866/7. General Electric Co., Ltd., Bayliss, A. J., and Peddle, E. A. R.—Apparatus for receiving and producing electric telegraph signals. 6th March, 1953. (733070/1.)

8291. General Electric Co., Ltd., Dale, S. H., and Thompson, W. G.—Electric power supply arrangements including one or more vapour electric arc rectifiers. 1st July, 1953. (733159.)

8379. International Polaroid Corporation.—Electric lamps. 2nd April, 1952. (733072.)

10874. British Insulated Callender's Cables, Ltd.—Manufacture of electric cables having oil impregnated insulation. 30th July, 1953. (732973.)

12540. Parsons, Ltd., C. H., and Handley, G. B.—Lever operated electric switches. 15th May, 1953. Cognate application 16205, 27th June, 1952. (733169.)

14895. Standard Resistance Welders, Ltd., and Reeves, C. J.—Electricity supply systems. 11th June, 1953. (732976.)

14944. Philips Electrical Industries, Ltd.—Cathode-ray tubes comprising luminescent screens. 13th June, 1952. (733077.)

15431. Parsons & Co., Ltd., C. A.—Heat exchangers. 10th September, 1952. (732977.)

17026. British Thomson-Houston Co., Ltd.—Circuit arrangements for operating electric-discharge lamps of the low pressure type. 7th July, 1952. (733171.)

18118. General Electric Co., Ltd., Elliot, E. W., and Griffith, W. S.—Thermionic valve circuits for amplifying television or like signals. 14th October, 1953. (733174.)

18858. Philips Electrical Industries, Ltd.—Apparatus embodying cathode-ray tubes. 25th July, 1952. (733176.)

19143. Dean, J. N.—Electric cables. 27th July, 1953. (733178.)

22175. English Electric Co., Ltd.—Electric isolator switches. 28th August, 1953. (732986.)

24592. Philips Electrical Industries, Ltd.—Ground lights. 1st October, 1952. (733182.)

24874. National Research Council.—Variable coupling means for microwave electromagnetic energy. 3rd October, 1952. (732990.)

24978. Philips Electrical Industries, Ltd.—Radar apparatus comprising a receiver the gain of which varies periodically. 6th October, 1952. (733312.)

26008. Minister of Supply.—Multi-vibrator circuits. 16th November, 1953. (733186.)

26729. English Electric Co., Ltd.—Electric cartridge fuse links and methods of manufacture thereof. 16th October, 1953. (732994.)

27080. Metropolitan-Vickers Electrical Co., Ltd.—Cathodes for electron emissive devices. 27th October, 1953. (733191.)

27377. Ahad, H. Abdul.—Radio receivers. 20th October, 1953. (733193.)

27442. Standard Telephones & Cables, Ltd.—Signal regulated electric power supply. 31st October, 1952. (733314.)

27476. General Electric Co., Ltd., Fisher, F. J., and Park, K. J.—Transformer and choke assemblies. 27th October, 1953. (733194.)

28127. Telefonaktiebolaget L. M. Ericsson.—Device intended to convert electric pulses into duration modulated pulses having steep leading edges. 7th November, 1952. (733199.)

28236. Wadsworth & Sons, Ltd., W., and Ryder, A. D.—Rectifying equipment. 5th October, 1953. (733200.)

28623. Beckman Instruments, Inc.—Dynamic capacitor modulator and electrometer using same. 13th November, 1952. (732995.)

30044. Electric Depot, Ltd., and Bill, E. H.—Adjustable arm supports for electric lamps or the like. 26th November, 1953. (733203.)

31558. Standard Telephones & Cables, Ltd.—Dry contact type rectifiers. 12th December, 1952. (733095.)

32476. Lodge-Cottrell, Ltd.—Synchronous motor rectifiers for electrostatic precipitating apparatus. 28th October, 1953. (733210.)

1953

850. Pye, Ltd.—Tunable radio communication equipment. 12th January, 1954. (733240.)

2227. Hivac, Ltd.—Cold cathode gas discharge tubes. 13th January, 1954. (733213.)

2547. C.A.V., Ltd.—Valves for liquid fuel injection pumps. 20th January, 1954. (733214.)

5029. Wolsey Television, Ltd.—Television aerials and mountings therefor. 10th November, 1953. (733010.)

5134. Compagnie Industrielle des Telephones.—Electromagnetically operated electric vibrator. 24th February, 1953. (733216.)

6047. Standard Coil Products Co., Inc.—Television tuners for receiving u.h.f. and v.h.f. signals. 4th March, 1953. (733012.)

6899. National Research Council.—Electromagnetic wave mixing devices. 12th March, 1953. (733014.)

7020. General Electric Co., Ltd., and Hunt, G. J.—Television relay systems. 15th March, 1954. (733219.)

7190. British Thomson-Houston Co., Ltd.—Fluorescent coating compositions. 16th March, 1953. (733318.)

7368. General Electric Co., Ltd., and Missen, J. I.—Crystal triode circuits. 24th February, 1954. (733250.)

8497. Allmanna Svenska Elektriska Aktiebolaget.—Means for square summation of the instantaneous values of two electric quantities. 27th March, 1953. (733254.)

9221. Siemens Bros. & Co., Ltd.—Line finder systems. 2nd April, 1954. (733020.)

9878. Sylvania Electric Products, Inc.—Electroluminescent lamps. 10th April, 1953. (733260.)

10277. Rotax, Ltd.—Commutators for dynamo-electric machines. 12th April, 1954. (733030.)

10428. Gossen & Co. Ges., P.—Arrangements for measuring the r.m.s. values of alternating currents and voltages. 16th April, 1953. (733261.)

10617. Allday & Son (1922), Ltd., H.—Wall box for containing an electric switch or other circuit controlling or connecting means. 8th April, 1954. (733031.)

11358. Standard Telephones & Cables, Ltd.—Hand micro-telephone for sound powered (batteryless) telephone systems. 24th April, 1953. (733263.)

12917. Standard Telephones & Cables, Ltd.—Arrangement of coupling coils in high frequency systems. 8th May, 1953. (733038.)

13653. Eaton Manufacturing Co.—Dynamo electric field member for electromagnetic clutches and the like. 15th May, 1953. (733265.)

13887. General Electric Co.—Titanium dioxide rectifiers. 18th May, 1953. (733267.)

14763. Philips Electrical Industries, Ltd.—Methods of electroplating recordings. 27th May, 1953. (733110.)

15303. Allmanna Svenska Elektriska Aktiebolaget.—Control means for static current convertors. 3rd June, 1953. (733272.)

15569. Standard Telephones & Cables, Ltd.—Method of making double-sided mosaic. 5th June, 1953. (733022.)

15580. Siemens Bros. & Co., Ltd.—Metering in automatic telephone systems. 4th June, 1954. (733023.)

17804. Western Electric Co., Inc.—Electrolytic capacitors. 26th June, 1953. (733025.)

20467. Leitz Ges., E.—Photo-electric cathodes. 23rd July, 1953. (733117.)

20876. Clarostat Mfg. Co., Inc.—Electrical resistance control. 28th July, 1953. (733285.)

21750. Reyrolle & Co., Ltd., A.—Bushing insulators for electrical apparatus. 4th November, 1954. (733044.)

26098. Mattsson, K. H.—Transformer system for obtaining zero-sequence current from a three-phase current supply. 22nd September, 1953. Addition to 732858. (733283.)

26892. Sylvania Electric Products, Inc.—Detachable electric plug connector. 30th September, 1953. (733291.)

28647. Radio Corporation of America.—Combined synchronizing pulse separator and direct current re-insertion circuit. 16th October, 1953. (733294.)

29336. English Electric Co., Ltd.—Electrical switchgear. 22nd October, 1954. (733049.)

29924. Research Corporation.—Electrode system for electrostatic precipitators. 29th October, 1953. (733328.)

30571. Telefunken Ges. für Drahtlose Telegraphie Ges.—Turret type tuning devices for electronic apparatus. 5th November, 1953. (733050.)

32704. Burgess Battery Co.—Primary electric cells. 25th November, 1953. (733300.)

1954

26800. Busche-Jaeger Dürener Metallwerke Akt.-Ges.—Rotary electric switches. 18th February, 1952. (733057.)

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses.

Australia.—7th July. State Electricity Commission of Western Australia. Three 440 V turbine auxiliaries starting boards. (E.S.B. 10867/55. Ten/13903.)*

28th July. Western Australian Government Tender Board. H.v. switchgear including 22 kV, 400 A circuit-breakers and isolators. (E.S.B. 10881/55. Ten/13914.)*

Durham.—9th June. County Council. Electrical installation at hostel for blind persons. (See this issue.)

Formosa.—15th June. Central Trust of China, U.S. Aid Division, Taipei. 7½-25 kVA transformers. (E.S.B. 10682/55. Ten/13921.)*

17th June. Two sets 850 V, 4,000 A mercury arc rectifiers. (E.S.B. 10658/55. Ten/13944.)*

9th and 28th June. Office of Supply, Government of the Republic of Korea. Ten 120 V generator sets, 5,000 l.v. insulators, lamps, voltmeters, etc. (E.S.B. 10689/55. Ten/13943.)*

India.—24th June. Superintending Engineer, 157, Mount Road, Madras. Equipment for the 33-11 kV substations, Mettur interconnection scheme. (E.S.B. 11194/55. Ten/13953.)*

Iraq.—15th June. Eastern Brewery Co., Ltd. 220/380 V refrigeration plant. (E.S.B. 11167/55. Ten/13950.)*

Irish Republic.—9th July. Louth County Council. Pumping and water filtration plant, electric wiring, etc., for the Louth, Mullacrew and Tallanstown villages water supply scheme. (E.S.B. 11250/55. Ten/13971.)*

Portuguese East Africa.—15th June. Permanent Purchasing Commission, Lourenço Marques. Three centrifugal pumps and ancillary equipment including one 220-380 V induction plant and remote control equipment. (E.S.B. 11111/55. Ten/13928.)*

South Africa.—9th June. Union Tender and Supplies Board. Radio valves. (E.S.B. 10787/55. Ten/13909.)* Radio testing equipment kits. (E.S.B. 11155/55. Ten/13949.)*

15th June. Stores Department, South African Railways. 6,600 V insulated cables. (E.S.B. 10862/55. Ten/13907.)* 22nd June. Cable installation test equipment. (E.S.B. 11116/55. Ten/13932.)* 22nd June. 660 V insulated and communication cable. (E.S.B. 11441-2/55. Ten/14002 and 14010.)*

Southern Rhodesia.—10th June. Director of Medical Services, Salisbury. Diagnostic X-ray apparatus. (E.S.B. 11306/55. Ten/13989.)*

Tanganyika.—16th June. Municipal Council of Dar-es-Salaam. Street lighting equipment. (E.S.B. 11137/55. Ten/13962.)*

Turkey.—16th June. Headquarters, Allied Land Forces, South Eastern Europe. Four radio communications receivers and one 1 kW transmitter. (E.S.B. 11213/55. Ten/13974.)*

Uganda.—Uganda Protectorate Public Works Department. Installation of electric lighting and power in Government buildings at Masaka and Soroti. (E.S.B. 10789/55. Ten/13902.)*

* Specifications may be inspected at the Export Services Branch, Board of Trade, Lacon House, Theobald's Road, London, W.C.1 (Chancery 4411; extension 769)

United States.—16th June. Bureau of Reclamation. Tie-line load and frequency control equipment. (E.S.B. 10680/55. Ten/13930.)*

17th June. U.S. Army Corps of Engineers, Tennessee. Electrical accessories for Cheatham power plant, including switchboards, 13·8 kV switchgear, etc. (E.S.B. 10969/55. Ten/14008.)*

Uruguay.—21st June. Administracion Nacional de Combustibles, Alcohol y Portland. 220 V armoured and rubber covered cables. (E.S.B. 11214/55. Ten/13972.)*

ORDERS PLACED

Barrow-in-Furness.—Housing Committee. Electrical installation work in 90 houses on the Margate Street estate (£3,383).—North Western Electricity Board.

Bradford.—Public Works Committee. Work in connection with electrical installations in houses on the Wood Side estate (£8,240).—J. Carter & Sons (Bradford).

Hull.—Corporation Telephones Committee. Telephone cable (£4,050).—British Insulated Callender's Cables.

London.—L.C.C. Accepted. Renewal and improvement of the electrical installation at Balham and Tooting College of Commerce, Wandsworth, and the schoolkeeper's house (£2,672).—A.A. Electrical Co., Ltd.

Middlesex.—Education Committee. Recommended. Improvement of the electric lighting at the Enfield (Chase Side) Schools (£1,193).—Iverson Electrical.

Stockport.—Corporation. Recommended. Electrical installations in 133 dwellings at Brinnington (£3,667).—A. B. Davenport (Electrical Contractors).

Warrington.—Corporation. Recommended. Re-wiring of Central Police Buildings (£1,498).—Lindsay Crawford Engineering.

Housing Committee. Lighting and power installations in approximately 180 houses on the Orford estate.—Charters Electrical Co.

West Hartlepool.—Corporation. Twelve months' supplies of electrical accessories for the Council's housing maintenance scheme.—T. J. Grainger.

Wisbech.—Isle of Ely County Council. Electrical, radio and internal communication system in Isle of Ely College of Further Education and Horticultural Institute (£5,240).—Ely Electrical Co.

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Aldridge.—Block of ten shops and offices at Beacon Buildings; C. Andreason, U.D.C. surveyor, Daw End, Rushall, near Walsall.

Bath.—Houses (118), with eight shops, etc., on site at Foxhill; J. Wilkinson, planning officer.

Birmingham.—Y.W.C.A. premises, incorporating flatlets, canteen, club, assembly hall, shops, etc., at corner of Bristol Road and Stone Road (£75,000); secretary, West Midland Division, 5, Lloyds Bank Chambers, New Street, 5.

Bolton.—Two additional classroom units at Markland Hill and adaptations to 68/70 Chorley New Road to form hostel for aged; borough engineer.

Boston.—Transport and salvage depot and stores behind the Council Offices (£14,500); R.D.C. architect, London Road.

Brierley Hill.—Large extensions to Cookley Steel Works (£2,000,000); Richard Thomas & Baldwins, Ltd., Wilden Ironworks, Stourport.

Brodsworth.—Proposed aged persons' hostel at Barnsley Road; county architect, Wakefield.

Cardiff.—Works, Newport Road estate; Standard Box & Carton Co., Ltd., Pentrebach, Merthyr Tydfil.

Crawley.—Works; W. J. Saville & Co., Ltd., 31, Eagle Wharf Road, London, N.1.

Croydon.—Cold store and offices, Frith Road; Thomas Borthwick & Sons, Ltd., Audrey House, Ely Place, London, E.C.1.

Dwellings (60), Selhurst New Road; borough engineer.

Transport maintenance depot at Factory Lane (£124,000), swimming baths at New Addington (£72,500), and improvements to Central Baths (£72,000); E. Taberner, town clerk.

Dagenham.—Factory in Selinas Lane; A. Gavurin, Ltd., fur merchants, Station Buildings, Cannon Street, London, E.C.4.

Darlington.—Works extensions; Darlington Engineering Co., Ltd., Team Valley Trading estate.

Dudley.—Central clinic (£56,000); F. H. Gibbons, borough surveyor, Council House.

Edmonton.—Dwellings (84), Fore Street; borough architect.

Ellesmere Port. — New factory for Bowaters Paper Corporation, Ltd.; Farmer and Dark, architects, Terminal House, Grosvenor Gardens, London, S.W.1.

Eston (Yorks).—Bottling factory at South Bank for Winterschladen & Co., Ltd., wine and spirit merchants, Zetland Road, Middlesbrough.

Frimley.—School, Burrow Hill (£180,000); L.C.C. Architects' Department, County Hall, Westminster Bridge, London, S.E.1.

Gosport.—Grammar school at Stanley Park; Hants. county architect, The Castle, Winchester.

Hendon.—Flats (68), Mill Hill and Edgware; borough engineer.

Office block, Finchley Lane; E. Daniel Hofmann, architect, 200, Gunnersbury Avenue, London, W.3.

Hull.—Dwellings (136), Longhill estate; city architect.

Works; Hedon Chemicals, Ltd., 20-21, St. James's Square, London, S.W.1.

Ilford.—Branch library, Fulwell Cross (£67,000); borough engineer.

Keighley.—Market hall (£60,000); E. G. Felgate, borough architect, College Street.

Keswick.—Public hall at Gatey's Court; R. Luther, U.D.C. surveyor.

London.—Works extension, Cricklewood; Fanfold, Ltd., 82-106, Cricklewood Lane, N.W.2.

Dwellings (589), Regent's Park estate, St. Pancras; Armstrong & MacManus, architects, 28, Gloucester Place, W.1.

Central library, Theobalds Road; borough architect, Town Hall, High Holborn, W.C.1.

Flats and maisonnettes (134), Finchley Road and Harben Road, Hampstead; Norman & Dawbarn, architects, 5, Gower Street, W.C.1.

Livery hall and offices, Harp Lane; The Bakers' Company, 116, Cannon Street, E.C.4.

Flats (47), at William Barefoot Drive Corner, Coldharbour estate, Woolwich; borough engineer, Town Hall, S.E.18.

Longbenton (Northumberland).—Factory at Benton Square for George Angus & Co., Ltd., Westgate Road, Newcastle-on-Tyne.

Luton.—Two school kitchens (£28,000); county architect, Bedford.

Maesteg.—Houses (40), Parc estate; Lewis W. Jones, U.D.C. surveyor, Talbot Street offices.

Maidenhead.—Municipal buildings on site at St. Ives; North and Partners, architects, 10, Queen Street.

Maidstone.—Workshops, offices, warehouse, etc., in Tovil Road; E. Sharp & Sons, Ltd., manufacturing confectioners, Kreemy Works.

Rebuilding and extension of premises, King Street for Vivish & Baker, Ltd., printers; C. Worthington, architect, St. Annes, Boxley Road.

Middlesbrough.—Rebuilding and extension of stores, Linthorpe Road for Marks & Spencer, Ltd.; Norman Jones and Rigby, architects, Lord Street, Southport.

Warehouse, office and showrooms, Cannon Street, for Middleton and Co.; Garbutt, Archibald and Archibald, architects, 23 Albert Road.

Warehouses, offices and showroom for Rd. Johnson, Clapham & Morris, Ltd.; Cross and Partners, architects, 20, Booth Street, Manchester.

Morpeth.—County C.D. training centre (£55,999); C. C. Brown, county architect, County Hall, Newcastle-on-Tyne.

Additions to Morpeth Cottage Hospital (£24,000); chief architect, Newcastle Hospital Board, "Dunira," Osborne Road, Newcastle-on-Tyne.

Newcastle-on-Tyne.—New stores, Northumberland Street, for W. Barratt and Co., Ltd.; Marshall and Tweedy, architects, 36, Blackett Street.

Houses (131), North Kenten estate; G. Kenyon, city architect.

Motor showrooms and offices, St. Mary's Place; E. M. Lawson, Barras Buildings.

Blocks of five storey flats, Shieldfield site; city architect.

Northfleet.—Additional factory premises; Bowater Paper Corporation, Ltd., Bowater House, Stratton Street, London, W.1.

Nuneaton.—Houses (68), Meadow Street; borough surveyor, Council House.

Oxfordshire.—Secondary schools at Marston and Eynsham, extensions to Bilateral School, Burford, to infants' school at Kidlington, to Secondary Modern School, Wheatley, to Junior School, Wheatley and to Woodstock Marlborough School canteen; county architect, Park End Street offices, Oxford.

Pinchbeck.—Houses (32) and bungalows (8), Brownlow Crescent; R.D.C. architect, Spalding, Lincs.

Plymouth.—Methodist church, Millbay Road; Sir Percy Thomas & Son, architects, 10, Cathedral Road, Cardiff.

Ramsbottom.—Houses (44) and maisonnettes (24), Tagg Wood estate; J. E. France, Orleans works, Peel Street, Newton Heath, Manchester.

Reading.—Works extensions; Pulsometer Engineering Co., Ltd., Nine Elms Ironworks, Tilehurst.

Secondary girls' school, Westwood, in two separate blocks; borough architect, Town Hall.

Redditch.—Houses (200), Studley Road estate; U.D.C. surveyor.

Richmond (Surrey).—Flats (100), Peldon Avenue; borough surveyor, Hotham House, Heron Court.

Solihull.—Civic hall block in Church Hill Road (first part of Civic Centre scheme); W. Maurice Mell, town clerk, Council House.

Stafford.—Bus station in town centre, including offices, café, etc. (£50,500); T. H. Higson, borough surveyor, Mount Street.

Stockport.—Civil building with extensions to Town Hall on site off Edward and Lacy Streets; W. F. Gardner, borough surveyor.

Stockton-on-Tees. — Reconstruction of cattle market on new site (£33,000); G. Cowan, borough surveyor.

Stoke-on-Trent.—Factory on the Newstead Farm industrial site; Tilsley and Lovatt, diesel engineers, London Road, Trent Vale.

Sunderland.—Temporary school buildings on the Hylton Castle estate (£7,500); borough architect, Grange House, Stockton Road.

Bus station, Park Road, Northern General Bus Co. (£100,000); Gordon Durham, Ltd., Boldon Lane, East Boldon.

Extension of factory, Fulwell Road; British Ropes, Ltd.

Swansea.—Warehouse and offices, White Street Lane; Astley Samuel, Leader & Son, 49, Mansel Street.

Troon.—Houses (45), with electrical work; Andrew R. McLeod, town clerk, Municipal Buildings.

Tynemouth.—Salesroom and warehouse; W. Stockdale, Howard Street, North Shields.

Wallsend.—Flats (54), houses (11); G. Teasdale, borough surveyor.

West Bromwich.—Works extensions; Birco Motor Cylinders, Ltd., Oldbury Road.

Whitby.—Redevelopment of Boulby Bank cleared area for the U.D.C.; Peacock and Bewlay, architects, 224, Hagley Road, Birmingham.

Whitley Bay.—Town hall and offices, swimming pool and car and coach park (£250,000); E. Roberts, borough surveyor.

Wood Green.—Municipal offices, High Road; Sir John Brown, A. E. Henson & Partners, architects, 117, Sloane Street, London, S.W.1.

York.—Grammar school, Nunsthorpe estate; city architect.

Retail store and offices, Spurriergate; F. W. Woolworth & Co., Ltd., 1, New Bond Street, W.1.

NEXT WEEK'S EVENTS

Organizers of electrical functions are advised to make use of the "Electrical Review" clearing house, Room 221, Dorset House, Stamford Street, London, S.E.1, to ascertain that proposed dates do not clash with others already arranged

Sunday, 5th June, to Tuesday, 7th June

MARGATE.—Electrical Contractors' Association. Conference.

Monday, 6th June

BOLTON.—Balmoral Hotel, Bradshawgate, 7.30 p.m. A.S.E.E. Bolton Branch. Annual general meeting.

BRISTOL. — Electricity House, Colston Avenue, 6 p.m. I.E.E. Western Centre. Annual general meeting.

ILFORD.—Angel Hotel, 7.30 p.m. A.S.E.E. North-East London Branch. Annual general meeting.

LEEDS.—Great Northern Hotel, 7 p.m. A.S.E.E. Leeds Branch. Annual general meeting.

Monday, 6th June, to Saturday, 11th June

NORTH OF SCOTLAND.—Institution of Electrical Engineers. Summer meeting.

Monday, 6th June, to Thursday, 16th June

LONDON.—Olympia. Business Efficiency Exhibition.

Tuesday, 7th June

CARDIFF. — Angel Hotel, Westgate Street, 7 p.m. A.S.E.E. South Wales Branch. Annual general meeting.

ELTHAM.—Congregation Church Hall, Court Road, 7.15 p.m. A.S.E.E. South-East London Branch. Annual general meeting.

HAMMERSMITH.—Windsor Castle Hotel, 134, King Street, 7 p.m. A.S.E.E. West London Branch. Annual general meeting.

LONDON.—At the Royal Society of Arts, John Adam Street, 7 p.m. Incorporated Plant Engineers, London Branch. A talk on work study by a member of the British Productivity Council.

MANCHESTER.—Engineers' Club, Albert Square, 7.15 p.m. Incorporated Plant Engineers, Manchester Branch. Open meeting.

Wednesday, 8th June

BIRMINGHAM.—Chamber of Commerce, New Street, 6.30 p.m. A.S.E.E. Birmingham Branch. Annual general meeting.

BRADFORD.—Midland Hotel, 7 p.m. A.S.E.E. Bradford Branch. Annual general meeting.

MANCHESTER.—Engineers' Club, Albert Square, 6.45 p.m. Women's Engineering Society, Manchester Branch. Annual general meeting and film show.

NOTTINGHAM.—E.M.E.B., Smithy Row, 7.30 p.m. A.S.E.E. Nottingham Branch. Annual general meeting.

YORK.—"Picture House Café," Coney Street, 7.15 p.m. A.S.E.E. York Branch. Branch annual meeting.

Thursday, 9th June

NEWCASTLE-UPON-TYNE.—Roadway House, Oxford Street, 7 p.m. Incorporated Plant Engineers, North-East Branch. "Steam for Process," by L. G. Northcroft.

Saturday, 11th June

OXFORD.—Y.M.C.A., 10, George Street, 6 p.m. A.S.E.E. Oxford Branch. Annual general meeting.

TRADE MARK APPLICATIONS

APPLICATIONS have been made for the registration of the following trade marks. Objections may be entered up to 11th June:—

PRESIDENT. No. 732,774, Class 7. Non-domestic electric floor polishing machines.—Bylock Electric, Ltd., 109, South Street, Enfield, Middx.

TIME-MASTER. No. 733,708, Class 9. Electrically operated sound recording and reproducing machines (none being for use in recording or reproducing time signals or other time indications), and parts.—Dictaphone Corporation, Bridgeport, Connecticut, U.S.A. Address for service, c/o Stevens, Langner, Parry & Rollinson, 5-8, Quality Court, Chancery Lane, London, W.C.2.

RONETTE. No. 736,097, Class 9. Apparatus for converting mechanical vibrations into electrical vibrations; apparatus for converting electrical vibrations into mechanical vibrations; electric cables, transformers, connections, microphones and stands, and gramophone pick-ups; and parts.—"Ronette" Piezo-Electrische Industrie, Amsterdam, The Netherlands. Address for service, c/o F. J. Cleveland & Co., 29, Southampton Buildings, Chancery Lane, London, W.C.2.

VICKI. No. 736,931, Class 9. Scientific, nautical, telegraphic, telephonic, television, radio, and acoustic instruments and apparatus and parts; gramophone pick-ups, radio aerials, electric batteries and accumulators.—Invicta Radio, Ltd., St. Andrews Road, Cambridge.

RADPRINT. No. 737,805, Class 9. Telecommunication apparatus for use in sending, receiving and recording printed matter, and parts.—International Aeradio, Ltd., Aeradio House, 40, Park Street, London, W.1.

DIATRON. No. 739,097, Class 9. Electronic apparatus for medical and surgical purposes.—L. Fothergill, P. B. Trier, W. B. Capewell, and A. D. Lewis, trading as Surgical & Medical Electronics, 322, Barrington Road, London, S.W.9.